UNIVERSITY OF EDINBURGH

ABSTRACT OF THESIS (Regulation 3.9)

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of Thesis ......Productivity and Innovation in Traditional Agriculture......
omparative study of agricultural development in the Bengal Presidency
0-1914 and the Forth Valley 1760-1841.

Why was there no agricultural revolution in Bengal after the Permanent Settlement of 1793? The Presidency is compared with the Forth Valley in Scotland where an agricultural revolution was successful. The theoretical framework for comparison is provided by the concept of the production function.

The first chapter establishes a valid chronology for comparison by applying Boserup's theory that technological change in agriculture is explained by population pressure, besides exploring changes in the environment. The second chapter constructs labour inputs for the major subsistence and commercial crops. Chapter three measures surplus labour and shows that there was no increase in the labour input to Bengal agriculture between 1890-1914. The fourth chapter argues that land tenure cannot explain the absence of capital formation in Bengal agriculture. In chapter five, we compared changes in total factor productivity by means of a Cobb-Douglas production function in the form of a price-dual equation. The results show that Bengal agriculture was not caught in a high level equilibrium trap, but was capable of technological change. Chapter six compares the costs and returns of innovation and shows that the attempts to raise output per acre with irrigation as the leading input did not give high returns. The last chapter examines the role of agriculture in economic development and the view that low productivity in Bengal agriculture is explained by an absence of demand. It shows that although the rate of increase in effective demand for food was higher than anywhere else in India, the rate of increase in food supply was actually lower. We conclude that the explanation for the absence of an agricultural revolution in Bengal lies not with the factors of production, but with the producer. Despite rising prices, the utility schedule of Bengal peasant farmers did not encourage them to work harder, perhaps because the marginal productivity was low, but also because they preferred leisure to higher incomes.

Productivity and Innovation in Traditional Agriculture: a comparative study of agricultural development in the Forth Valley 1760-1841 and the Bengal Presidency 1870-1914.

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Glossary

abwab, illegal cess

ail, raised earth perimiter around plot

ahimsa, non-violence

aman, winter rice grown between June-December

anna, coin; sixteenth part of rupee

aus, summer rice grown between March and July

bari, homestead

bear/bigg, four rowed barley hardier than ordinary two rowed kind

bhagdar, sharecropper

bhil, shallow depression or lateral spill basin

bigha, land measure; usually equivalent to 0.302 imperial acres

boro, spring rice grown between December and April

char, alluvial island

chowkidar, village watchman

danga, high land on river bank

dhenki, device for husking paddy

dhoti, male garment

gantidar, tenure-holder

gur, brown unrefined sugar made from sugarcane juice

hat, market

jotedar, tenure-holder

khal, channel or artificial canal

khas, owner operated

kutcha, opposite of *pucca*; used to describe wells without a hard lining

korfa/*korfadar*, cultivator without tenure

mahajan, money-lender; literally, 'big man'

maund, weight; equivalent to 0.832 hectolitres

mouza, revenue unit, normally a village

nal, land measure

patta, lease

panchayat, village council

pari/*paribar*, neighbourhood; caste territory within a village

patwari, village accountant, zamindari official

pice, coin; one fourth of an anna

purdah, veil; seclusion of women

rabi, winter crop

raiyat/*ryot*, cultivator with tenure; not applied before 18th century

rupee, major denomination of Indian currency

taccavi, government loans to farmers

thana, police circle; administrative unit

til, small grain; also yields edible oil

wecht, wooden hoop about 2-3 feet in diameter with skin or canvas stretched over it to form a tray, used for winnowing corn

zamindar, literally landholder; term coined in 14th century

Weights and Measures

Weights

1 *tola*	=	11.664g.
1 *seer*	=	0.933 kg
1 *maund*	=	0.382 hl.

1 Stirlingshire boll (wheat, peas, beans) = 1.559 hl.

1 Stirlingshire boll (oats, barley, malt) = 2.254 hl.

1 Roxburgh boll (oats, barley, malt) = 2.247 hl.

Measures

1 *bigha*	=	1600 sq. yards or 0.302 imperial acres
1 Scots acre	=	6150 sq. yards or 1.270 imperial acres

Money

1 pice (1/4 of an anna) = 1-1/2 farthings

1 anna (1/16 of a rupee) = 1-1/2 pence

1 rupee = 2 shillings

To convert £ Scots to sterling, divide by 12

Rice extraction rate

1 ton paddy = 0.68 tons milled rice

Source: R. E. Zupko, "The Weights and Measures of Scotland before the Union", Scottish Historical Review, vol. LVI, No. 2, (Oct, 1977), pp. 119-145.

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1. 3 S.P. Chatterjee, R. Lahiri, S.N.Mukherjee, "Classification of Alluvial Soils of Howrah, West Bengal", Geographical Review of India vol XXII No 13, (Sept, 1960) p. 7; Arthur N. Strahler, Physical Geography (New York, 1960 2nd edn) pp. 240 Fig 16.4 and p. 239 Fig 16.3

1. 4 Strahler, op. cit., p. 237 Fig 16.1.

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1. 7 Bilquis Jahan, Some aspects of the historical geography of East Pakistan, 1608-1857 (Ph.D Thesis, London 1968), Fig 29.

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1.11 A.T.A.Learmonth, "Some Contrasts in the Regional Geography of Malaria in India and Pakistan", Transactions of the Institute of British Geographers vol 23 (1957) p.5 Fig.13.

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1.13 John B.Fleming, Crofthead Corn Harvest Notebook. A Study (Edinburgh B.Sc. dissertation, Economic History 1977) Fig.8.

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4. 3 Keith Griffin, Land Concentration and Rural Poverty (London, 1981 2nd. edn) p. 193 Fig 5.1.

4. 4 Charles Issawi, "Farm Output under Fixed Rents and Share Tenancy" Land Economics vol 33, (1957) p. 75. Chart 2.

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5. 2 Census of Great Britain, 1851 Population Tables II, Parliamentary Papers vol 88(2) pp. 1029, 1033.

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Introduction

This thesis is a historical comparison of technological change in traditional agriculture. Its purpose is twofold: to explain the absence of an agricultural revolution in Bengal after the Permanent Settlement and by so doing to demonstrate the value of the comparative method to Indian historians.

The problem

Our story opens in 1793 when the Governor General and Council of Bengal, the representatives of the English East India Company, made a revolutionary change in the system of land taxation. They did two things. First, they vested the old tax-collectors under the Mughals, the *zamindars*, with private property rights. Second, they fixed the land tax or revenue which the *zamindars* paid to the state "now and forever". The new system consequently became known as the Permanent Settlement[1].

The primary objective of the Permanent Settlement was political. It ensured the regular payment of land revenue to the state with the minimum of cost and inconven-

1. B. H. Baden Powell, *Land Systems of British India*, (London, 1892), vol. 1, pp. 389-442.

ience to administrators, and it gate the zamindars a vested interest in the continuance of British rule by creating a priviliged comprador elite. But its secondary objective was economic. It was to transform the agricultural sector in Bengal in the same way that agriculture in Britain was then being transformed. The Permanent Settlement was based on an impeccable logic of rationality. By introducing private property rights and fixing a permanent ceiling on taxation, it was designed to turn zamindars into enterprising landlords who by investing capital in improvements would make Bengal the scene of a second agricultural revolution.

The Permanent Settlement remained in force for nearly 160 years, as an act of law. But long before its abolition in independent India in 1949, its economic results were recognised as disastrous. The anticipated revolution in Bengal agriculture simply failed to materialise. What went wrong? Why did private property in land, the magic which British improvers believed turned sand into gold, work no miracle on the alluvium of Bengal? Why did a fixed tax demand give zamindars no incentive to invest? This problem in diverse forms continues to puzzle historians.

"The really complex problem, for which no one has yet put forward convincing solutions is Greater Bengal. It is the area of the first substantial British penetration in in India. It is the area of the old capital of the British Empire in India, Calcutta. It is the area of the great development of industry in India, and it remained the center of British operations in India until 1911, when the capital was transferred to New Delhi. It is also the area of the most developed of the Indian languages, Bengali.

Here, in this region which one might have thought would have benefitted from the coming of western civilisation, western administration and modernisation, we find that we are faced with what looks like an absolute decline in food output, from the 1890's to the 1940's... What we are faced with apparently, is a secular decline in agricultural output in what was previously the richest area in India"[2].

2. Daniel Thorner, "Agricultural Productivity since the 1890's". Third International Conference of Economic Historians, (Munich, 1965), vol. 2, pp. 276-277.

The method

To help us see these questions in their true historical perspective, this thesis is comparative. The comparative method is closely identified with the work of the French historian, Marc Bloch[3]. In fact, there is no single comparative method: three quite different approaches are involved[4]. Our approach is logically the same as Bloch's. Bloch's method was "to choose from one or several social situations, two or more phenomena which appear at first sight to offer certain analogies between them; then to trace their line of evolution, to note the likenesses and the differences between them and, as far as possible, to explain them"[5]. This approach has been that of contrasting contexts. But, whereas Bloch stressed the need for basic similarities between the units of comparison, we would emphasise the differences. This approach is logically analogous to Mill's "Method of Difference",

3. Marc Bloch, "Pour Une Histoire Comparee des Societes Europeenes", in J. E. Anderson, trans. Land and Work in Medieval Europe; selected papers, (London, 1967), pp. 41-71. For an assessment, see William H. Sewell,"Marc Bloch and The Logic of Comparative History". History and Theory, vol. 6 (1967), pp. 208-218.

4. Theda Skocpol and Margaret Somers, "The Uses of Comparative History in Macro-Social Enquiry", Comparative Studies in Society and History, Vol. 22, No. 2, (April 1976), p. 176.

5. Bloch, in Anderson, op. cit., p. 45.

i.e. the contrast between two cases, one positive, where the phenomena to be explained and the hypothesised causes are present, the other negative, where the phenomena and the causes are both absent, although they are as similar as possible to the positive case in other respects[6].

It might be argued that the contrasts between the cases we have chosen are so extreme as to rule out the possibility of fruitful comparisons. What insights are to be gained by comparing Scotland and Bengal, two areas so radically different in virtually every respect? Even the exercise of comparing their agricutlure may seem open to question. As one contemporary expressed it:

> "The agriculture of the Tropics presents few points of resemblance to that of the Temperate regions. In the latter portion of the globe, the agriculturalist is obliged to employ much skill and unwearied industry, both acquired by long experience, to reap at the best a scanty crop. His skill is required to arrange the operations of the field, accord-ding to the various climates which are presented to him in the course of the year. One advantage, however, he possesses with these varied climates - they succeed each other in regular succession, so that his operations assume a similar regular-

6. Skocpol and Somers, op. cit., p. 183.

> ity. His industry is required to preserve them from destruction, and cherish with care and nourishment, the fruits of his toil; and as the destructive elements of air and water are irregular and uncertain in their effects on his crops, his industry is necessarily unceasing for their preservation. In the tropics, the amazing luxuriance of vegetation implies a rich soil and a genial climate, in every situation and season. There the agriculturalist may have little anxiety for the safety of one crop, for nature bountifully supplies him annually with three. His industry is never called forth, his wants and desires being satisfied with little exertion. In short, no two individuals can be placed in more opposite circumstances than the agriculturalists of the tropical and temperate regions"[7].

Yet, there remain strong justifications for a comparative approach. Comparative, firstly, because the Permanent Settlement itself was based on just such a comparison. The model of modernisation on which the Permanent Settlement was based had its theoretical foundation in the doctrines of the physiocrats and classical economists. These were rooted in Western and, indeed, in Scottish experience. The ideaology of the Permanent Settlement derived from the work of two Scotsmen,

7. Anon, "On the Agriculture of the Tropics", Quarterly Journal of Agriculture, vol. 4, (1832-34), No. LXVIII, p. 565.

Alexander Dow and Henry Pattullo. The latter's Essay upon the cultivation of the lands, and improvement in, the Revenues of Bengal, (1772), which advocated private property rights as the cure for agricultural stagnation, is "remarkable for its fine blending of intellectual conviction of French origin with the experience of contemporary developments in the Scottish countryside"[8]. Hence, in contemporary minds, the comparison between Bengal and Western agriculture was direct.

Comparative, secondly, because this Scottish connection was more than mere coincidence. Scottish agrarian reformers and theorists developed the first coherent theory of the role of the agricultural sector in economic development, seen in terms of a transition from feudalism, a word which they themselves invented to describe Scottish conditions[9]. The transformation of agriculture in the Scottish lowlands was particularly rapid and far-reaching. Changes began to spread in the 1760's, and by the 1830's Scottish agriculture was acknowledge to be technologically the most advanced in Europe. The Scottish comparison may, therefore, be justified on the grounds that the agricultural revolution in Scotland was the paradigm of the changes in productivity which also occurred elsewhere.

8. Ranajit Guha, A Rule of Property for Bengal; an essay on the idea of permanent settlement, (Paris, 1963), p. 48.

9. E.J. Hobsbawm, "Scottish Reformers of the 18th Century and Capitalist Agriculture", in E.J. Hobsbowm et al, Peasants' in History. Essays in Honour of Daniel Thorner, Ch. 1, pp. 3-29; or "Agriculture et capitalisme en Ecosse an XVII^{e} siecle" Annales E.S.C., 33 Annee, No. 3 (Mai-Juin, 1978), pp. 580-601.

Comparative, thirdly, because of what we are trying to compare. All comparisons require an organising central theme within which specfic questions can be asked and hypotheses tested. But few such themes are suitable for comparisons between such very different regions.

> "Among the few that are of general applicability,, there is the concept of a production function together with all its derived notions. But this is due to the purely physical nature of that concept. Most economic concepts are hard to transplant".[10]

Production in all societies shares certain common characteristics. It requires, first of all, the existence of the things required for making acommodity. These must be labour, natural resources and certain tools, implements and other capital goods. In economic terminology, these are called inputs. They are commonly grouped into three for the purpose of analysis as the factors of production: land, labour and capital. A production function is, therefore, "the technical relations telling the maximum amount of output capable of being produced by each and every set of specified inputs (or factors of production).

10. N. Georgescu-Roegen, "Economic Theory and Agrarian Economics". Oxford Economic Papers, vol. 12, No. 1, (Feb. 1960), pp. 3-4.

11. Paul A. Samuelson, Economics, (Tokyo, 1980 11th edn) p. 501.

It is defined for a given state of technical knowledge"[11] By structuring our comparison around the production function we thus avoid the trap of comparing dissimilar entities.

The method we have adopted to answer this question imposes strict limitations on the scope of our comparison. While comparing the production function of both agricultures has the advantage that the phenomena to be compared are carefully specified, this narrow definition of agricultural development omits important non-economic variables. Yet as P.T. Bauer has pointed out, "material advance depends largely on factors and forces outside the concern of contemporary formal economic analysis".[12] One such factor is the elusive complex of attitudes and aspirations summed up in the word mentalitie. The limitation of comparative economic history and of this study is its inability to control for such non-observed and possibly non-observable variables.[13] This necessarily limits the validity of our conclusions.

Comparative, finally, because all traditional agricultures, whether tropical or temperate, may be accommodated within a single theoretical framework which sees agricultural development as the result of population pressure on land. Two agricultural systems are therefore "in phase" and are comparable if there is evidence of sufficient population pressure to stimulate innovation.[14] This explains the choice of different periods for

12. P.T.Bauer, Dissent on Development; studies and debates in economic development (London, 1971) p. 516.

13. Rondo Cameron, "Comparative Economic History", in Robert E. Gallman, Research in Economic History Supplement 1 (Greenwich 1977) p. 296.

14. Ester Boserup. The Conditions of Agricultural Growth; the economic agrarian change under population pressure (London, 1965).

comparison. We argue that the periods 1760-1840 in Scotland and 1870-1914 in Bengal were both characterised by population pressure. Hence the comparison may be justified on a theoretical level because both agricultures were passing through a comparable stage of development. Two periods, one problem - why was there no agricultural revolution in Bengal?

Explanations for the absence of an agricultural revolution in Bengal after the Permanent Settlement fall roughly into three categories: ecological, social, and economic.

The ecological explanation is examined in Chapter I, which compares the resource-base of both agricultures and the effect of changes in environment on agricultural production.

Chapter 4 examines the social explanation by comparing systems of land tenure and considers the argument that the benefits from rising prices in Bengal went to landlords not farmers.

The economic explanations are examined in the remaining chapters. Chapters 2 and 3 compare labour productivity through a reconstruction of labour inputs to agriculture.

Chapter 5 examines the argument that Bengal agriculture was caught in a high-level equilibrium trap, through a comparison of growth rates of total factor productivity.

In Chapter 6 we compare price relationships through an analysis of the costs and returns of innovation.

Finally, Chapter 7 looks at the argument that low productivity in Bengal agriculture was the result of an absence of demand.

The data

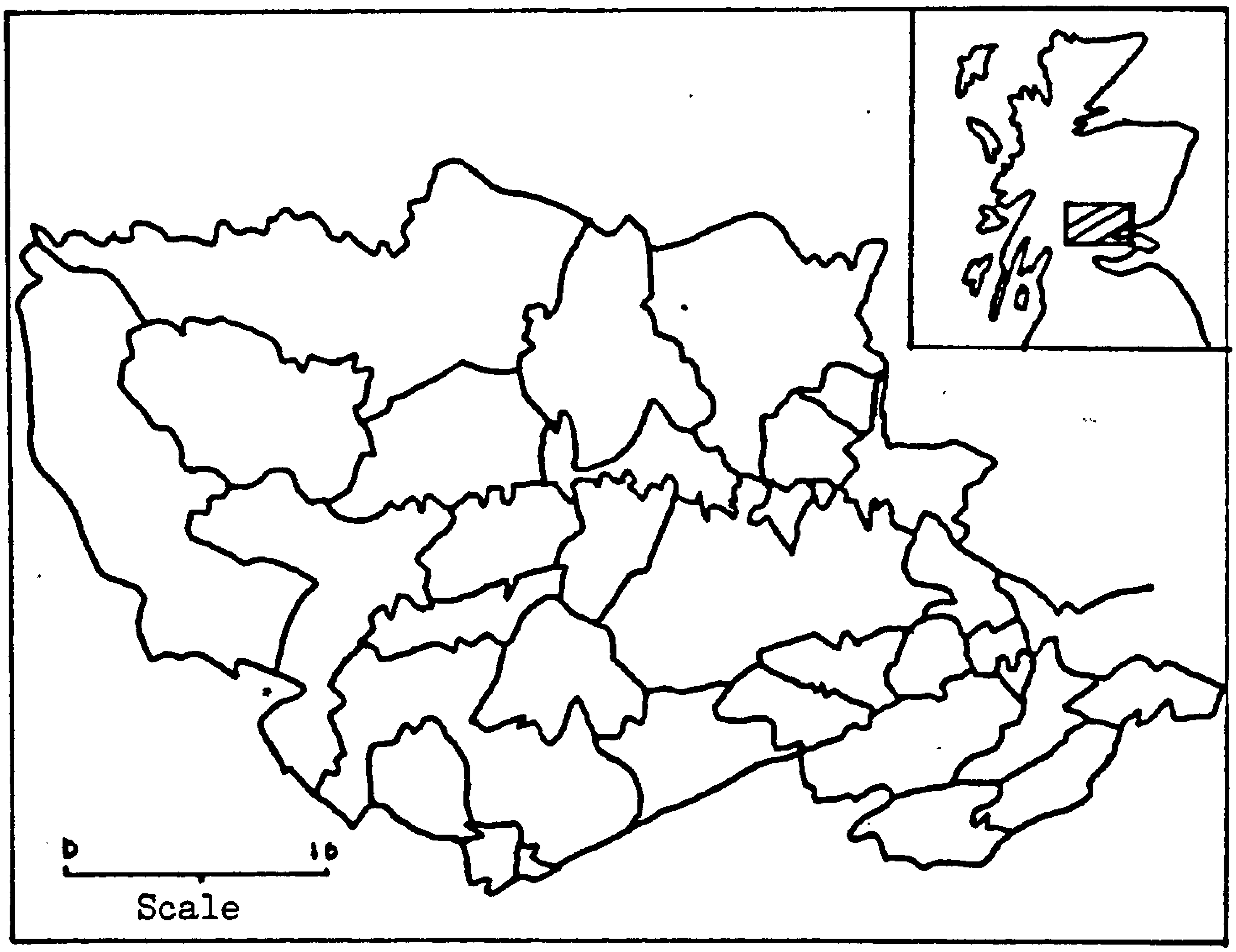
Comparative history is open to the charge of superficiality since perforce it leans heavily on secondary sources. This thesis is no exception and the extent of its debt to other historians is evident from the bibliography. Nevertheless, it proved impossible to rely solely on published or unpublished secondary material and most of the historical evidence derives from primary sources. In order to simplify the task of primary research, two procedures were followed.

First, a sampling technique was used. For Scotland, the Forth Valley region was chosen for comparison. The main criterion in selection was the region's diversity. Besides being in the vanguard of the Scottish agricultural revolution, the range of landholding and farm size was greater than elsewhere in the lowlands. For Bengal, four districts were chosen for study: Burdwan, Jessore, Dacca, and Purnea. Their selection was determined largely by the available source material but within these limits an attempt was made to secure the widest possible geographical range. All four districts differ widely in their micro-conditions and together may be said to be representative of the delta as a whole. Both regions are shown in Figure 1.

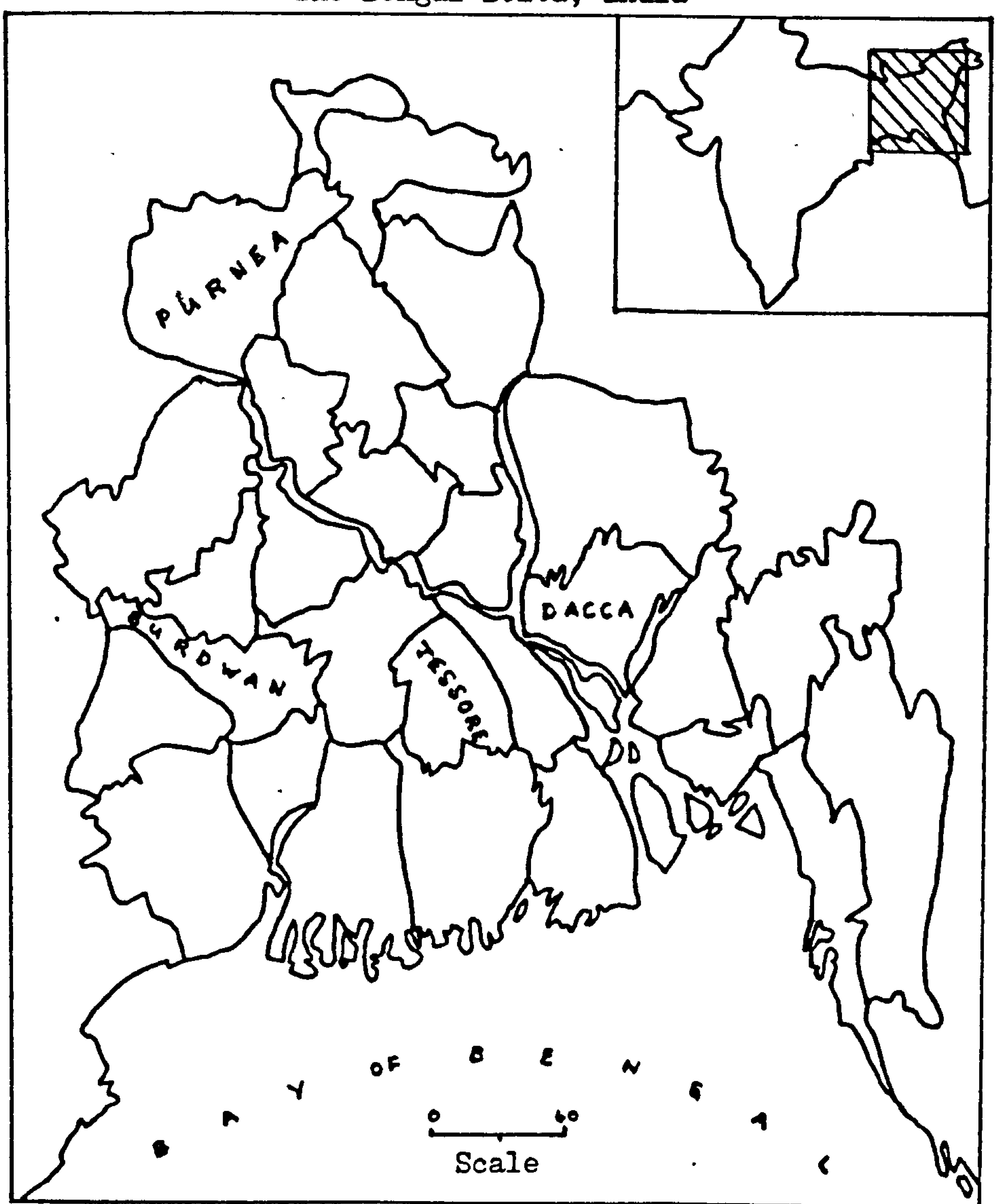
Second, printed primary sources were used wherever possible. Scottish interest in the new husbandry sparked an enormous increase in demand for books on agriculture.

Comparative Agricultural Development: Study Areas

The Forth Valley, Scotland



The Bengal Delta, India



Encyclopedias, manuals and treatises poured from the presses.[15] The major source proved to be the series of General Views on the agriculture of each county commissioned by the Board of Agriculture between 1793-1816; each county was covered at least twice.[16] Not all reports were of equal quality: Arthur Young complained that some of the authors scarcely knew the right end of a plough.[17] Yet the General Views of Stirling and Clackmannan were both written by local observers, one an improving landlord.[18] No similar coverage exists for Bengal, but two detailed reports on the agriculture of Burdwan and Dacca supplied most of the necessary information on cultivation practices.[19]

15. J.A.S.Watson and G.D.Amery, "Early Scottish agricultural writers 1697-1790", Transactions of the Highland and Agricultural Society of Scotland, Fifth Series vol XLIII (1931) pp. 60-85; G.E. Fussell and H. Fyrth, "Eighteenth Century Scottish Agricultural Writings", History vol 35 (Feb-June 1950) pp. 49-63; G.E.Fussell, "Nineteenth Century Farming Encyclopedias: A Note" Agricultural History vol 5 No 1 (January 1981) pp 16-20.

16. Listed in J.A.Symon, Scottish Farming Past and Present (Edinburgh 1959) Appendix 1 pp. 440-452.

17. Quoted Rosalind Mitchison, "The Old Board of Agriculture", English Historical Review, vol LXXIV (1959) p. 49.

18. Patrick Graham, General View of the Agriculture of Stirlingshire (Edinburgh, 1812); John Francis Erskine General View of the Agriculture of the County of Clackmannan (Edinburgh, 1795)

19. A.C. Sen, Report on the System of Agriculture and Agricultural Statistics of the Dacca District (Calcutta 1889), Report on the Agricultural Experiments and Enquiries in the Burdwan Division (Calcutta, 1897)

A second valuable source for the Forth Valley was the Old and New Statistical Accounts of Scotland which contain descriptions of each parish in the 1790s and 1840s.[20] The value of the Old Statistical Account for agricultural historians is enhanced by the fact that its editor Sir John Sinclair was also the first President of the old Board of Agriculture, and that many of the ministers who wrote the parish reports, like James Lapslie and Robert Rennie, who contributed the two longest and most detailed accounts of agriculture in Stirlingshire, were themselves the sons of farmers.[21] There is a direct equivalent to the Scottish version in William Hunter's Statistical Account of Bengal which provides detailed descriptions of the agriculture in each district of the Bengal Presidency in the 1870s, while the latter end of the period is covered by the series of District Gazetteers.[22] At the macro-level unfortunately there is no Scottish equivalent to K.L.Datta's Report on the Enquiry into the rise of prices in India, which was our source for the agricultural statistics of Bengal between 1890-1912.[23]

20. The Statistical Account of Scotland 1791-1799 edited by Sir John Sinclair. General editors Donald J.Withrington and Ian R. Grant, vols IX (Ilkley 1978), XII (Ilkley 1977) henceforth OSA. The New Statistical Account of Scotland vol, 8 (Edinburgh, 1845) henceforth NSA.

21. I.M.M.Macphail, "Introduction", OSA vol IX p.xi, xii.

22. William Hunter, A Statistical Account of Bengal (London, 1876) 20 vols. henceforth SAB.
L.S.S.O'Malley et al, Bengal District Gazetteers, (Calcutta, 1906-23) 35 vols.

23. K.L. Datta, A Report on the Enquiry into the Rise of Prices in India (Calcutta, 1914) 5 vols.

Agricultural development is a holistic process. The search for secondary sources was extended to other disciplines in the social sciences whenever it proved impossible to test hypotheses against what is conventionally defined as historical evidence. Marc Bloch once said that the good historian is like the giant in the fairy tale: wherever he smells human flesh, there his quarry lies.[24] The result is a study which depends strongly on the work of geographers and development economists. Nevertheless it remains a work of agricultural history. Behind the models and formulae there lies, in the evocative words of Lucien Febvre, "a history which smells of the good earth, of the countryside, of toil and of harvest."[25]

24. Marc Bloch, The Historian's Craft (Manchester, 1954) p. 26.

25. Lucien Febvre, Combats pour L'histoire (Paris, 1953) p. 393.

CHAPTER ONE: LAND

"L'homme utilise le milieu physique, mais par
l'entremise d'une certaine civilisation".

Pierre Gourou

Land was the primary input in the production of both agricultures. Land in this context refers not simply to area but to a basic resource with its complement of soil, climate and topography. The first aim of this chapter is, therefore, to compare the resource base in Scotland and Bengal in order to determine the influence of physical factors on agricultural development. Since the resource base may change over time, it will also be necessary to identify these changes and compare their impact on agricultural production. The second aim of this chapter is to establish a valid chronology for such comparisons by applying Ester Boserup's theory that increases in land productivity are the result of population pressure. Evidence of population pressure on land in Bengal after 1870 and in Scotland after 1760 is provided by a variety of indicators: physical, demographic and economic. We argue that both traditional agricultures were in phase in the period after these dates.

The chapter is divided into three sections. Section I compares the resource base. In section 2, we contrast changes in this resource base over time. Finally, section 3 brings together evidence to support the hypothesis of population pressure.

Section I: Environment

Production possibilities in traditional agriculture are severely limited by three physical constraints: soil, topography and climate. In this section, we compare how differences in soil and topography in Bengal and the Forth Valley influenced agricultural development.

The physical areas of our comparison are shown in Figures 1-1 and 1-2. It is obvious that we are not comparing land areas of similar size. The Forth Valley as defined here consists of 36 parishes with a total land area of 800.43 square miles[1]. By contrast, Bengal as we have defined it consisted of 24 districts with a total land area of 74374 square miles[2]. The Forth Valley would have fitted comfortably into any one of the districts shown in Figure 1-2. Although this in no way invalidates our comparison since the unit of comparison, the region, is the same, yet the difference in scale is clearly important when we come to compare absolute totals like population or capital investment.

1. Parish acreages from Eighth Decennial census of the Population of Scotland, 1871, with Report (Edinburgh, 1872), vol. 1, Table 1: Scotland in civil count ies and parishes. There was no change in the parish boundaries during the intercensal period 1801-1877. See Census of Scotland, 1871 (Edinburgh, 1973), vol. 1, parts 5 and 6. Perth and Stirling tables.

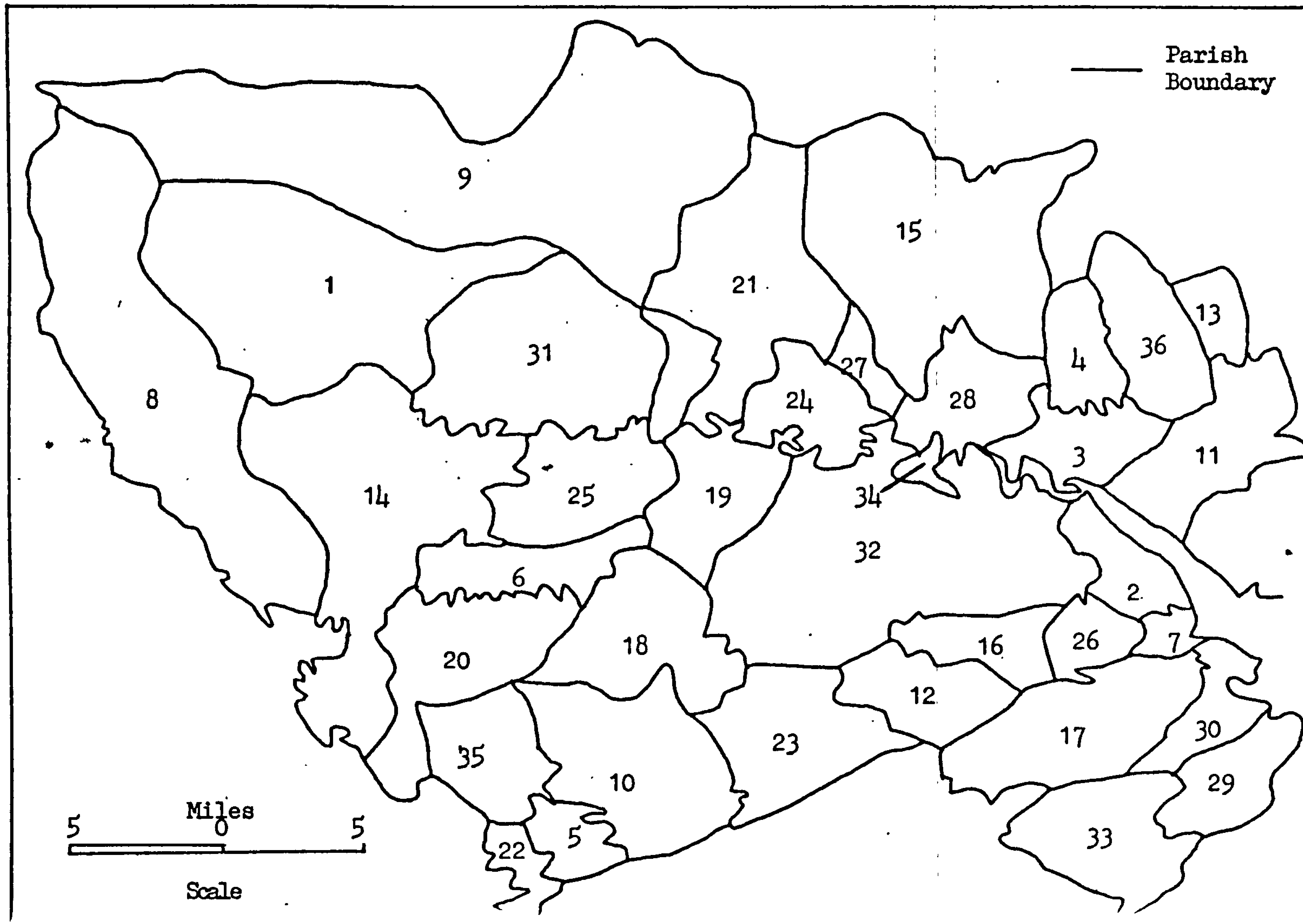
2. Census of India, 1911 (Calcutta, 1913), vol. 5. Bengal, part II, Tables, Table 1, Bihar and Orissa, Part III, Tables, Table 1.

Figure 1.1

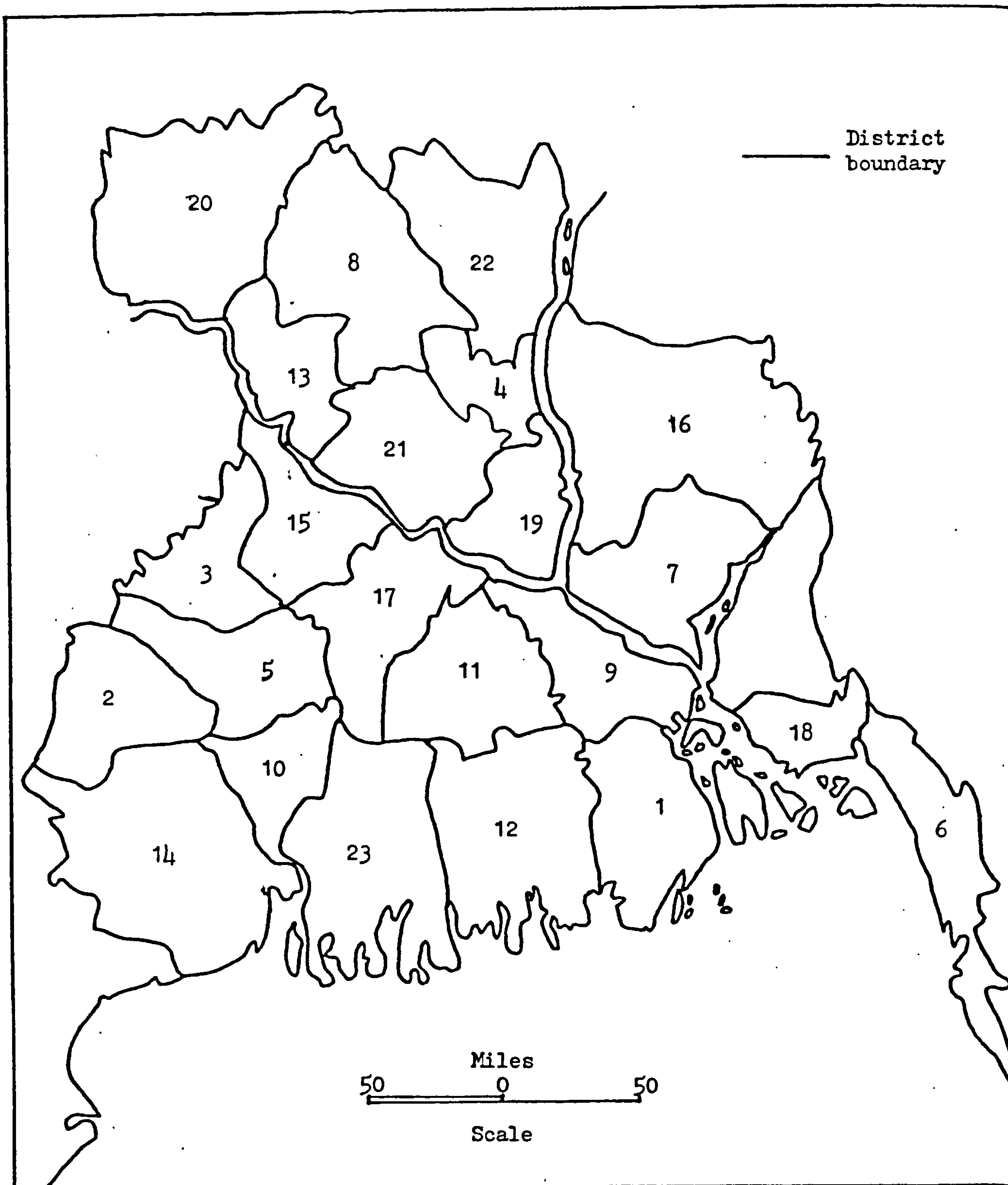
The Forth Valley: study area

Parishes

1 Aberfoyle	23 Kilsyth
2 Airth	24 Kincardine
3 Alloa	25 Kippen
4 Alva	26 Larbert
5 Baldernock	27 Lecropt
6 Balfron	28 Logie
7 Bothkennar	29 Muiravonside
8 Buchanan	30 Polmont
9 Callander	31 Port
10 Campsie	32 St Ninians
11 Clackmannan	33 Slamannan
12 Denny	34 Stirling
13 Dollar	35 Strathblane
14 Drymen	36 Tillicoutry
15 Dunblane	
16 Dunipace	
17 Falkirk	
18 Fintry	
19 Gargunnock	
20 Killearn	
21 Kilmadock	
22 Kilpatrick East	



The Bengal delta: study area



Districts

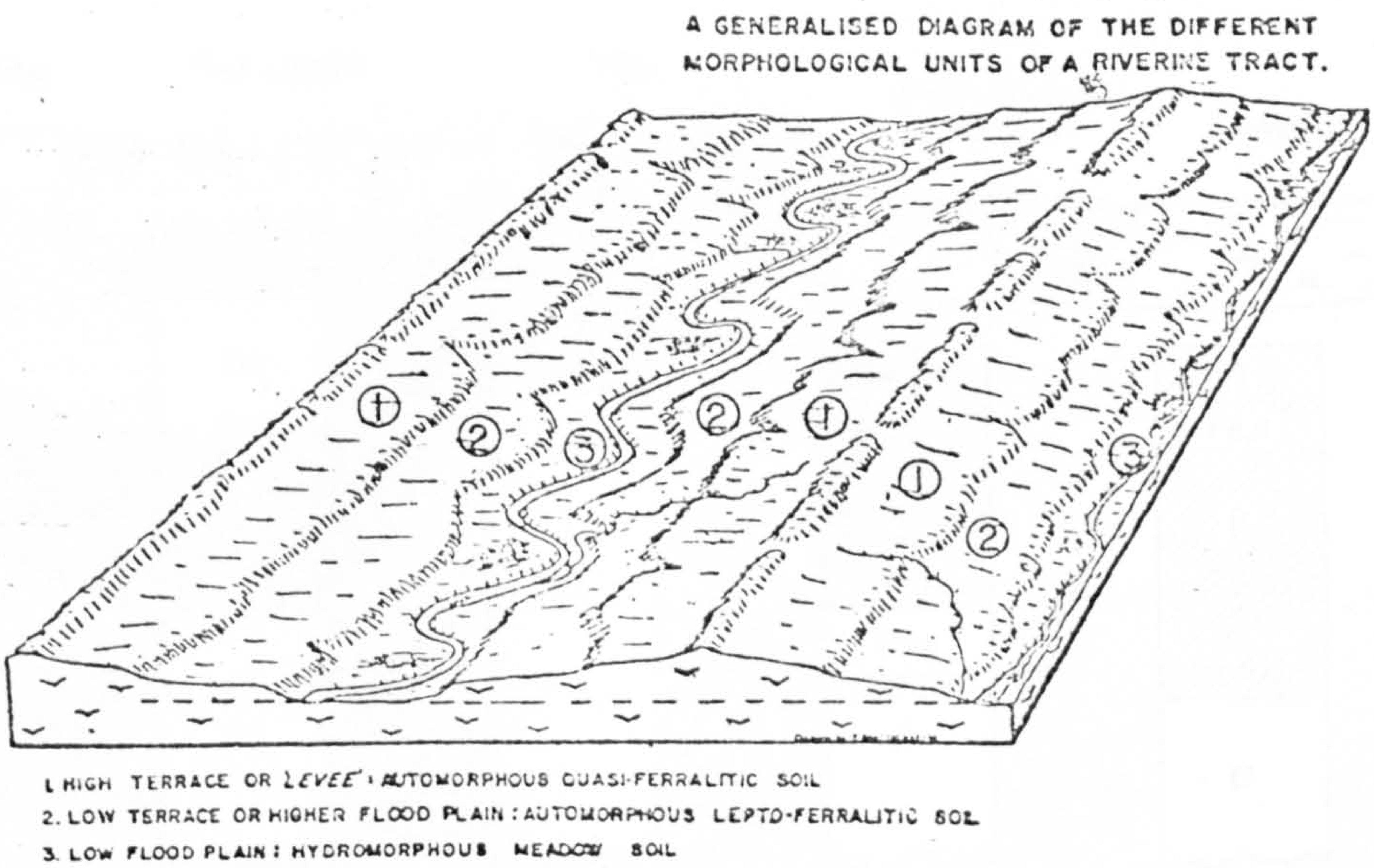
1 Backerganj	9 Faridpur	17 Nadia
2 Bankura	10 Hooghly	18 Noakhali
3 Birbhum	11 Jessore	19 Pabna
4 Bogra	12 Khulna	20 Purnea
5 Burdwan	13 Malda	21 Rajshahi
6 Chittagong	14 Midnapur	22 Rangpur
7 Dacca	15 Murshidabad	23 Tippera
8 Dinajpur	16 Mymensingh	24 24 Perganas

The topography of both regions stands in stark contrast. Bengal is a delta, where the topography is the result of alluvial flooding. This has produced a distinctive three-step formation with each step corresponding to a different level of land. These three levels are shown in Figure 1-3. The top step is the levee or the river bank known in Bengali as danga. The second step is the lower terrace; this is known as sona or sali land. Finally, the third and lowest step is the flood plain, known as bhil. This simple three-step formation determines the production possibilities of traditional agriculture in Bengal.

By contrast, topography in the Forth Valley is the result not of alluvial floods but of glaciation. This has produced a much less uniform environment and a wider choice of production possibilities than in Bengal. The various types of topography are illustrated in Figure 1-4. The Forth Valley may be broadly divided into a three-step formation similar to that found in Bengal. The lowest level on the Valley floor consists of poorly drained meadow. This was known in the Forth Valley as the Carse. The second level is the undulating country above the Carse known as the Dryfield. The name, as one contemporary noted, "was by no means descriptive of the nature of the soil, but

Figure 1.3
Environment: Bengal

Topography and soil development



Soil textures

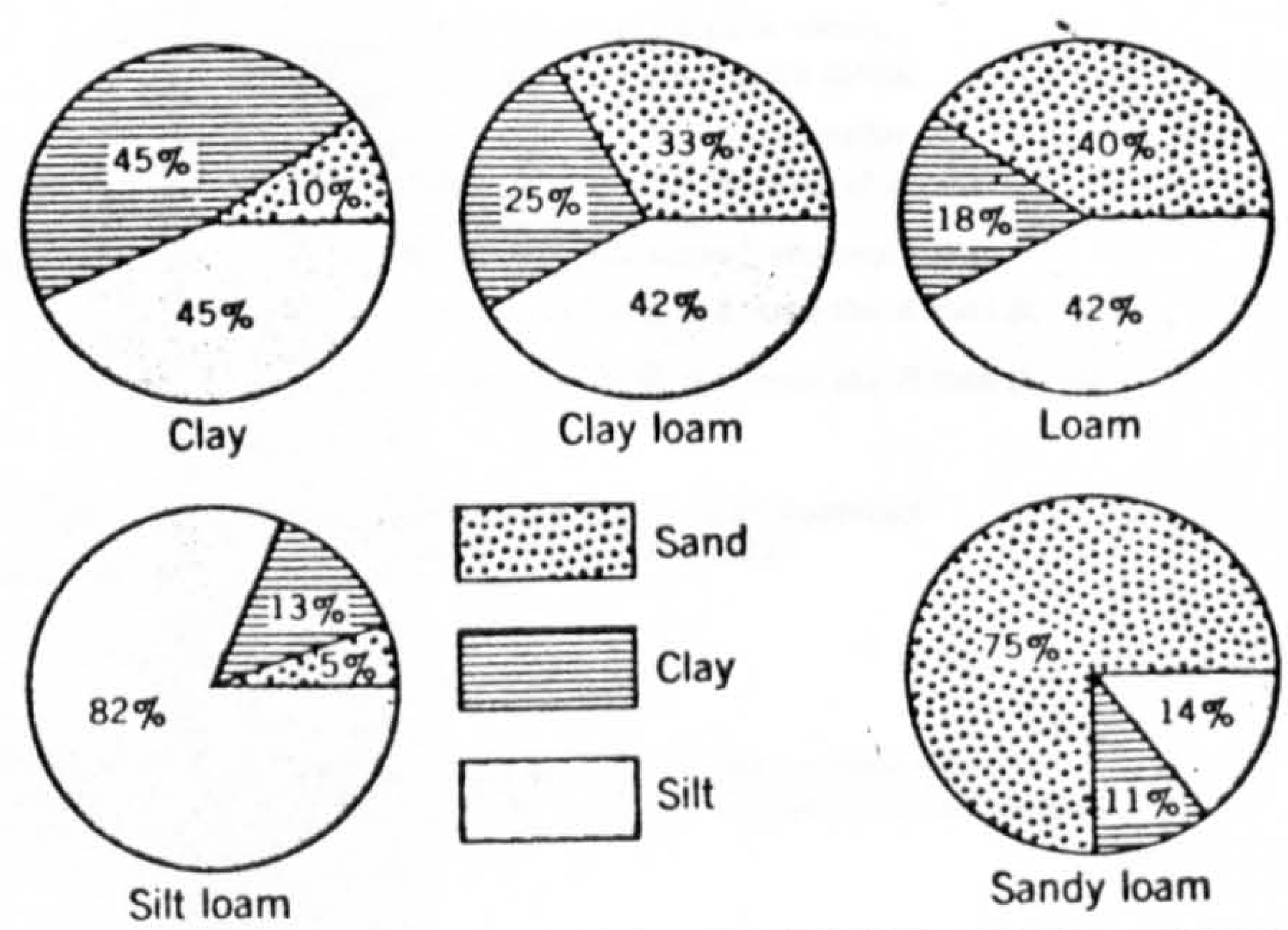
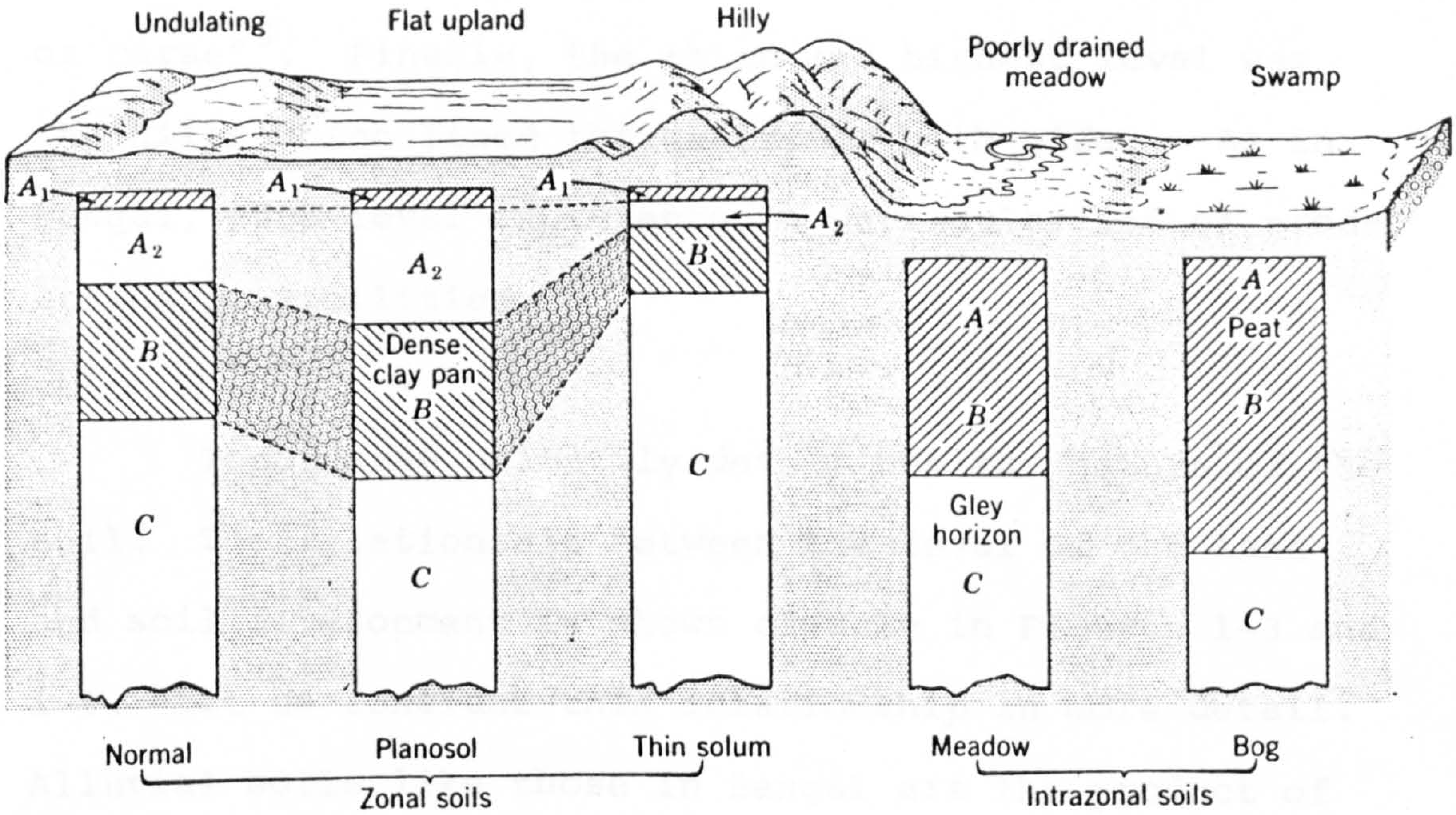
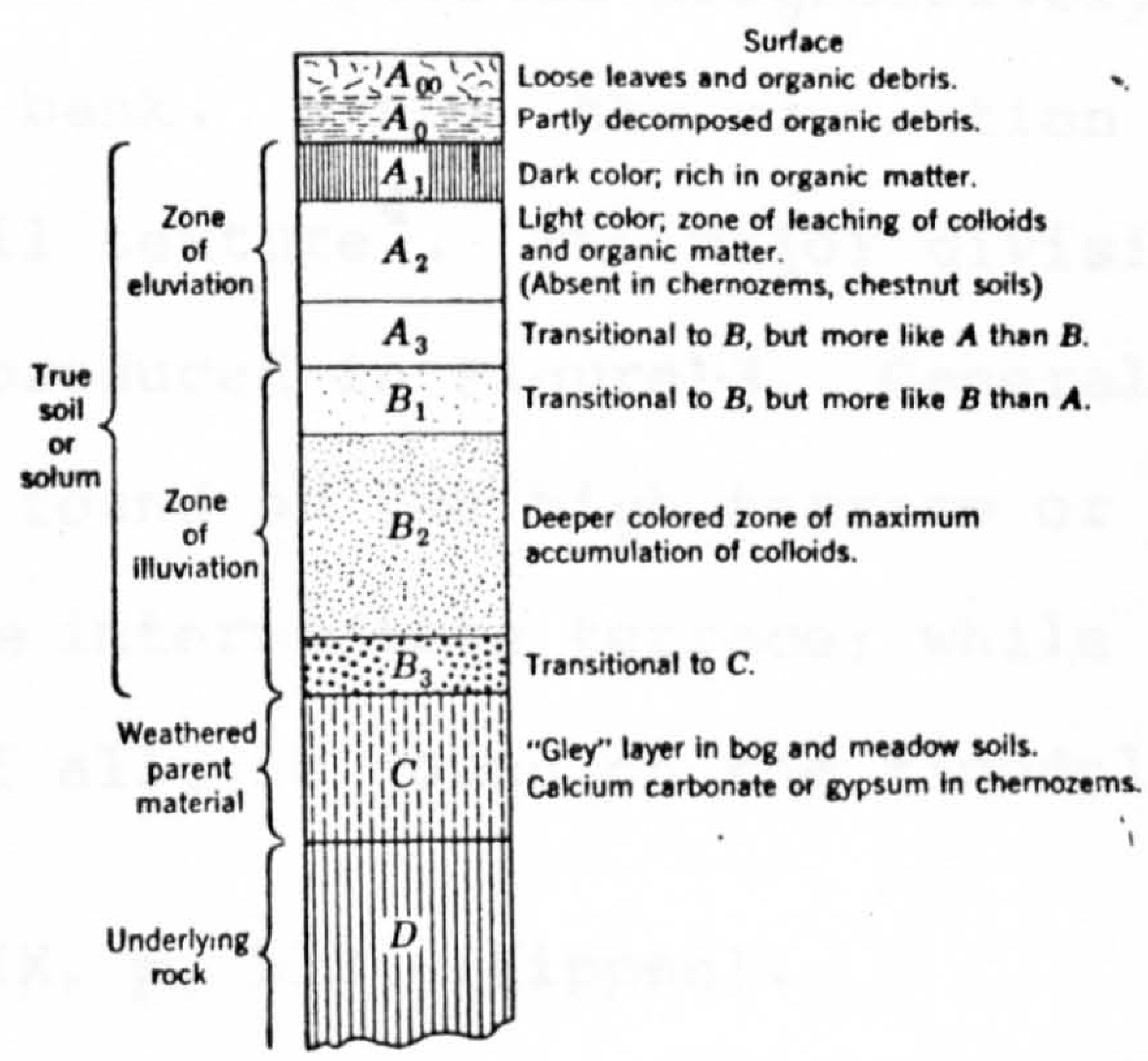


Figure 1.4
Environment: the Forth Valley

Topography and soil development



An idealised soil profile



is used merely to distinguish it from the lower ground or carse"[3]. Finally, the third and highest level was the hills which lined the Valley on both sides. As in Bengal, each level represented a particular set of production possibilities.

Topography primarily determines the nature of the soil. The relationship between the level of the land and soil development is shown clearly in Figures 1-3 and 1-4. Let us consider this relationship in more detail. Alluvial soils like those in Bengal are the product of riverine floods. When a river floods its banks, however, alluvium is not deposited at random. Floods have an internal logic. Sandy alluvium is deposited first near the levee because it is heavier, while the ligher alluvium like silt or loam is deposited progressively further away from the river bank. Hence the connection between topography and soil texture[4]. The major divisions of soil texture are reproduced in Figure1·3. Generally, sand and loam soils are found on the high terrace or levee; silt is found on the intermediate terrace; while clay, the heaviest texture of all, is found on the floodplain itself.

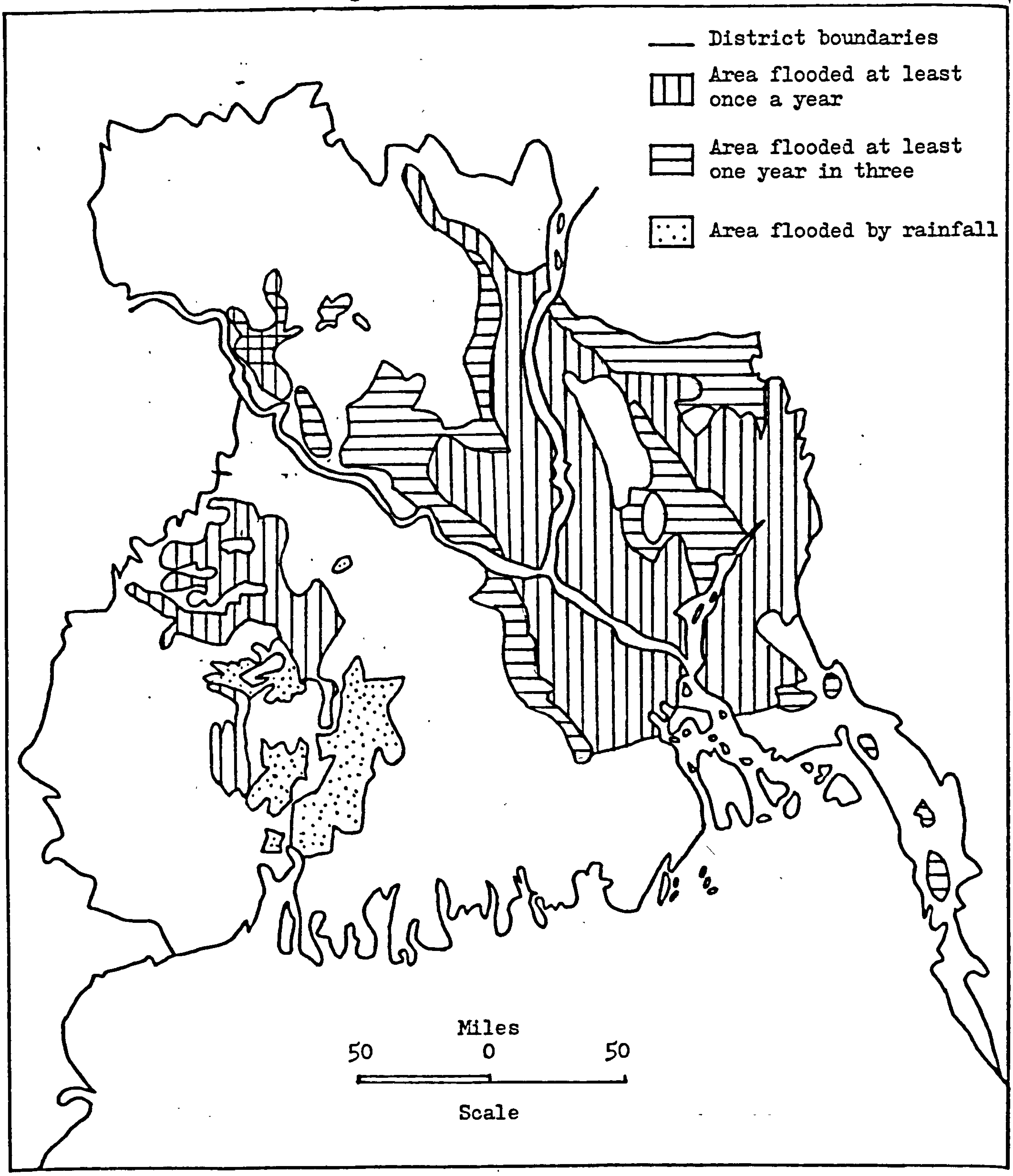
3. OSA, vol. IX, p. 518, (Kippen).

4. Harunar Rasid, "Morphology of the Jamuna Flood Plains", Oriental Geography, vol, x, No. 2., (July, 1966), pp. 61-62.

Topography in the Forth Valley is again closely linked with soil development but with quite different results. Alluvial soils are azonal: regular flooding prevents any clearly developed soil profile. By contrast, in the Forth Valley where soils are zonal, soil texture is less important for agricultural purposes than the soil profile. This is made up of four horizons reproduced in Figure 1-4. Horizons A and B represent the solum or true soil. The depth of the solum is closely related to topography. Hilly relief, for example, has a thin solum which is poor in plant nutrients whereas undulating relief with a deeper solum has greater soil fertility. Hence, in the Forth Valley, the production possibilities are determined by the soil profile whereas in Bengal they are determined by soil texture.

With some understanding of the importance of topography and soil development, we may now turn to the question of their distribution. Figure 1-5 shows the broad pattern of alluvial floods in Bengal. It is important to note that the flooded areas shown derive from modern data and, therefore, do not correspond exactly with those of the period 1870-1914. Nevertheless, two points stand out. First, the floods do not cover the entire delta but are confined to certain areas, about 57% of the total land area. Even in the areas most affected by floods, the

Figure 1.5
Bengal environment - flooded area



flooded area is a relatively small proportion of the total. In modern Bangladesh, for example, the flooded area forms only one-third of the total land area[5]. Second, some areas are never flooded at all. The shaded areas indicate the boundaries of the old alluvium found in the Madhapur Jungle, the Barind and the Rarh. These areas are raised above the floodplain. Clearly, a large proportion of the cultivated area is not dependent on alluvial floods.

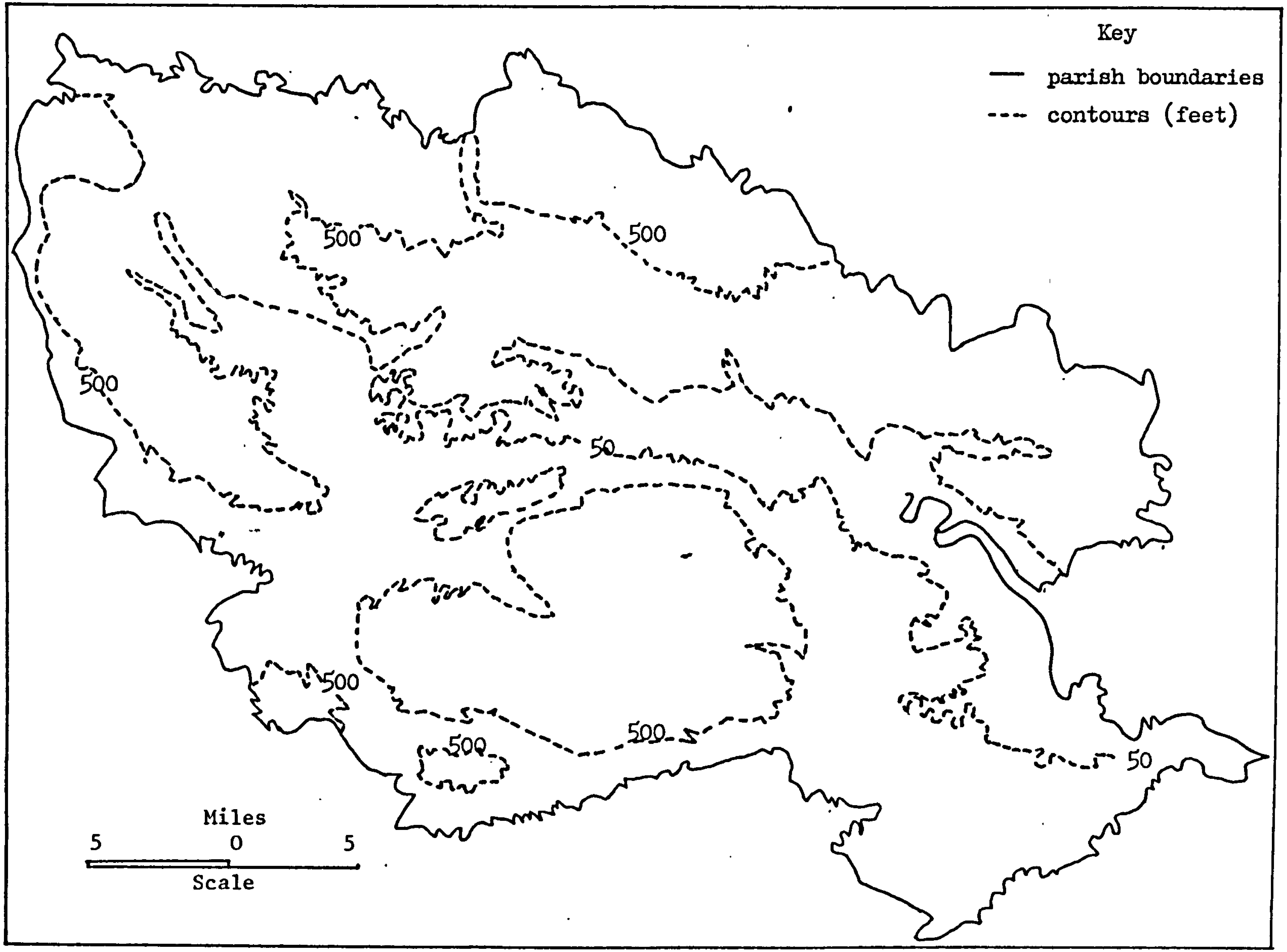
The distribution of Carse, Dryfield and moor in the Forth Valley is shown in Figure 1-6. Carse land on the Valley floor is indicated by the 50 foot contour line. The Dryfield is shown as the land between 50-500 feet. Above 500 feet are the hills[6]. The contours show that the Valley is bounded on the north by the Grampians, the Highland foothills and the Ochils, and on the south by the Campsie Fells and the Slammannan plateau. Using this classification the relative shares of different kinds of agricultural land to total area are: carse 12.74%, dry-field 48.51% and moor 38.73%. What conclusion may be drawn from this comparison of topography as to production possibilities in Bengal and the Forth Valley? Firstly,

5. M. Aminal Islam, "Agricultural Adjustments to Flooding in Bangladesh: A Preliminary Report". National Geographical Journal of India, vol. 26. Parts 1-2. (March-June, 1980). p. 50, note.2.

6. Jesse L. Carson, "Summary of a paper entitled a Geographical Description of the District, Stirling, Alloa, Culross to Auchterarder", Transactions of the Stirlinghsire Natural History and Archaeological Society, November, 1911,.p. 12.

Figure 1.6

Forth Valley environment: Carse, Dryfield and Moor



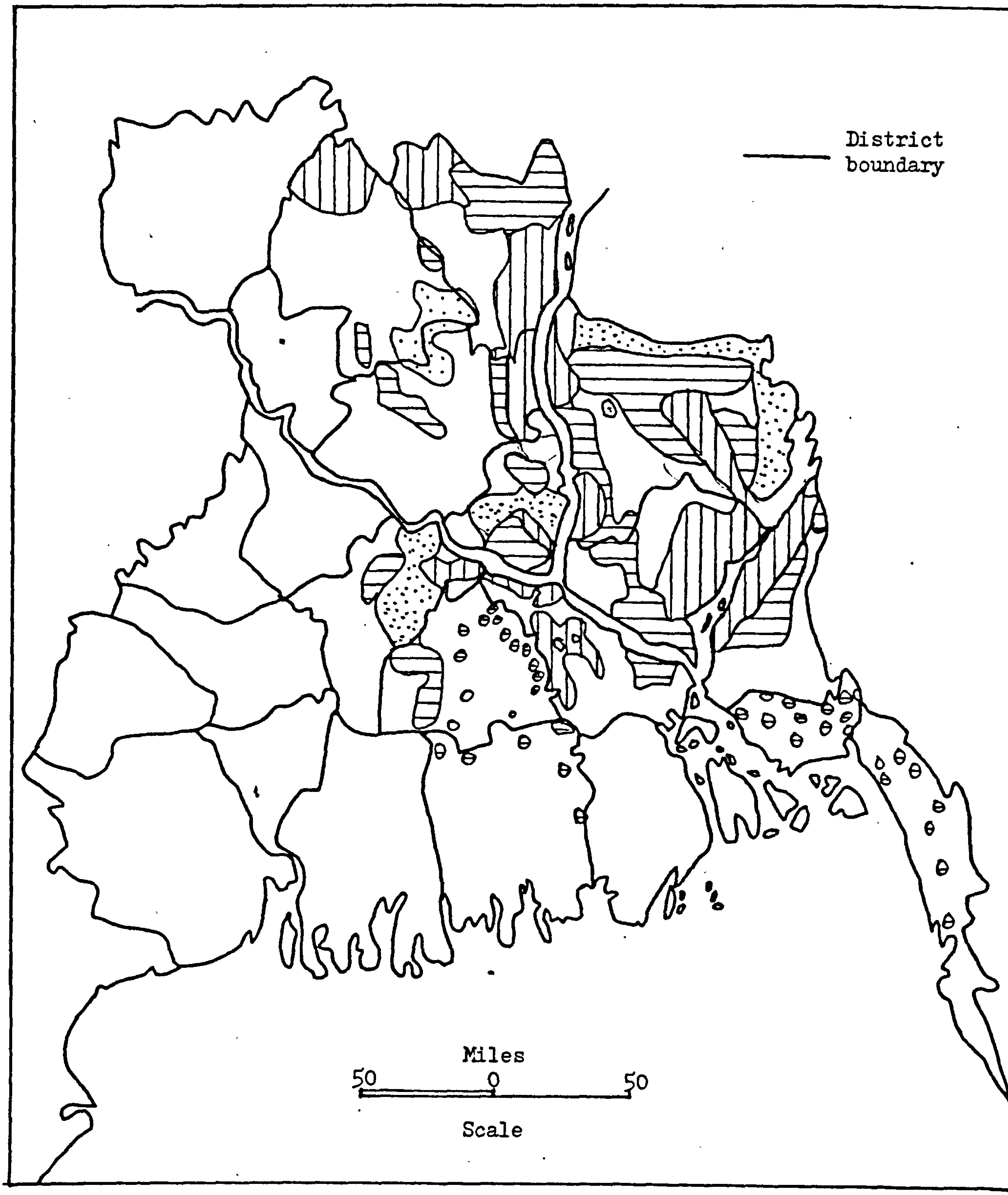
it is evident that the range of substitution between different crops was much narrower in Bengal. Topography determined soil texture and the depth of the seasonal floods, and therefore which crops could be grown. Aman, the major rice crop, could be grown only on the intermediate terrace or the second step. Similarly, aus which was the secondary rice crop could be grown only on the first step or levee. These crops cannot be substituted because they are subject to a physical constraint, the depth and duration of the annual floods. This was quite different from the Forth Valley. The only important physical constraint on oats, the staple cereal, could be overcome by effective drainage. The importance of this physical constraint in Bengal is illustrated by the introduction of jute. Because of the danger of flooding, jute could be grown only on high land and had to be substituted for a rice crop, aus. This limited the area on which jute could be grown.

Jute was grown only in one region of the Bengal delta. (Fig. 1-7). For agricultural purposes, therefore, it is convenient to divide Bengal into two separate regions: the jute producing North and East, and the rice producing South and West[9].

9. K. L. Datta, Report on the Enquiry into the Rise of Prices in India (Calcutta, 1914), vol. 1, pp. 193-194. South & West: Chittagong, Noakhali, Backerganj, Khulna, Hooghly, Howrah, Midnapore. For statistical purposes, Balasore, Cuttack, Puri, and Angul in Orissa are included in S & W Bengal. N & E: Jalpaiguri, Rangpur, Dinajpur, Malda, Rajshahi, Bogra, Pabna, Mymensingh, Dacca, Tippera, Faridpur.

Figure 1.7

Jute growing area, Bengal 1870



key

superior quality jute

medium quality jute

inferior quality jute

Secondly, the level of the land also limited the extent of double-cropping. Aus and transplanted aman could be grown together only where the floods were not above one foot in depth in September, since otherwise aman could not be transplanted[10]. Aman had therefore to be grown on relatively high land. Again, this represented a physical constraint on the allocation of resources.

Thirdly, the level of the land determined both the timing and the duration of the seasonal floods. This was even more serious a constraint than soil texture:

> The really essential factor which determines the value of any given field is not so much the soil of which it is composed, but the depth of the water which stands on it inthe rains and it is the height and duration of the flood even more than the local rainfall which determines whether the harvest in Dacca will be good or bad[11].

While high land was not flooded at all, the Bhils on the floodplain were waterlogged for six months in the year.

10. Census of India, 1921, vol. V, Bengal. Part 1, Report, p. 13, para. 11.

11. B. C. Allen, Dacca. Eastern Bengal District Gazetteers (Allahabad, 1912), p. 89.

Finally, these same constraints made innovation difficult. Traditional agriculure in Bengal represented an adaptation to a volatile environment which rendered many of the techniques for raising land productivity in the Forth Valley redundant:

> "The land is mostly clayey, is submerged under water during the rains, and remains dry only for a short time... It is difficult to see how improved ploughs, new staples, concentrated and soluble manures, can find any very important place in the husbandry of the lowlands of this part of the country, forming at least 80 per cent of the cultivated area, ..."[12]

On the other hand, soil fertility was probably higher in Bengal than in the Forth Valley. Fertility is a measure of the soil's ability to supply essential plant nutrients, particularly calcium, magnesium and potassium. Ions of these minerals are known as bases. The fertility of tropical soils is a controversial subject among geographers[13]. Tropical climates can adversely affect soil

12. A. C. Sen, Report on the Agricultural Experiments and Enquiries in the Burdwan Division, (Calcutta, 1897), p. 3.

13. cf. P. A. Sanchez and S. W. Buol, "Soils of the Tropics and the World Food Crisis", Science, vol. 188, No. 4188, (9 May, 1975), pp. 598-601, and Jen-Hu Chang. Tropical Agriculture: Crop Diversity and Crop Yields", Economic Geography, vol. 53, (1977), pp. 248-250.

fertility because heavy rainfall during the monsoon can leach vital bases, while high temperatures can prevent the development of humus. Consequently, some areas of the tropics are characterised by infertile soils known as laterites. In Bengal, laterites are found in areas of old alluvium[14]. Such soils produce only one crop of rice a year (aman). But they form a small proportion of the total land area. Most of the land consists of new alluvium which are rich in bases[15].

By contrast, soils in the Forth Valley were much less fertile. Most of the land area is occupied by gleys and gleyed brown forest soils[16]. These soils are waterlogged and relatively poor in nutrients, and occupy most of the Dryfield. Above the Dryfield on the hills over 650 feet are found podzols and peat. Podzols are infertile soils where the bases have been leached by heavy rainfall. Similarly peat is strongly acidic and infertile. The only soil in the Forth Valley which bears comparison

14. A Karim and A. Quasem, "A Study of the Soils of Barind Tract, East Pakistan", Soil Science, vol. 91, No. 6, (June, 1961), pp. 83-87, 406-412; S. J. Bhunan, Rahman F. Zacheria, "Soils of the Khiyar Tract, East Pakistan". ibid, pp. 369-374; R. N. Chowdhury, "Laterites of West Bengal", Geographical Review of India, vol. 35, (March 1973), pp. 61-72.

15. See H. Brammer's exhaustive analysis: Soil Survey Project. Bangladesh, Soil Resources. (F.A.O., Rome, 1971), AGL:SF/PAK 6, Technical Report 3.

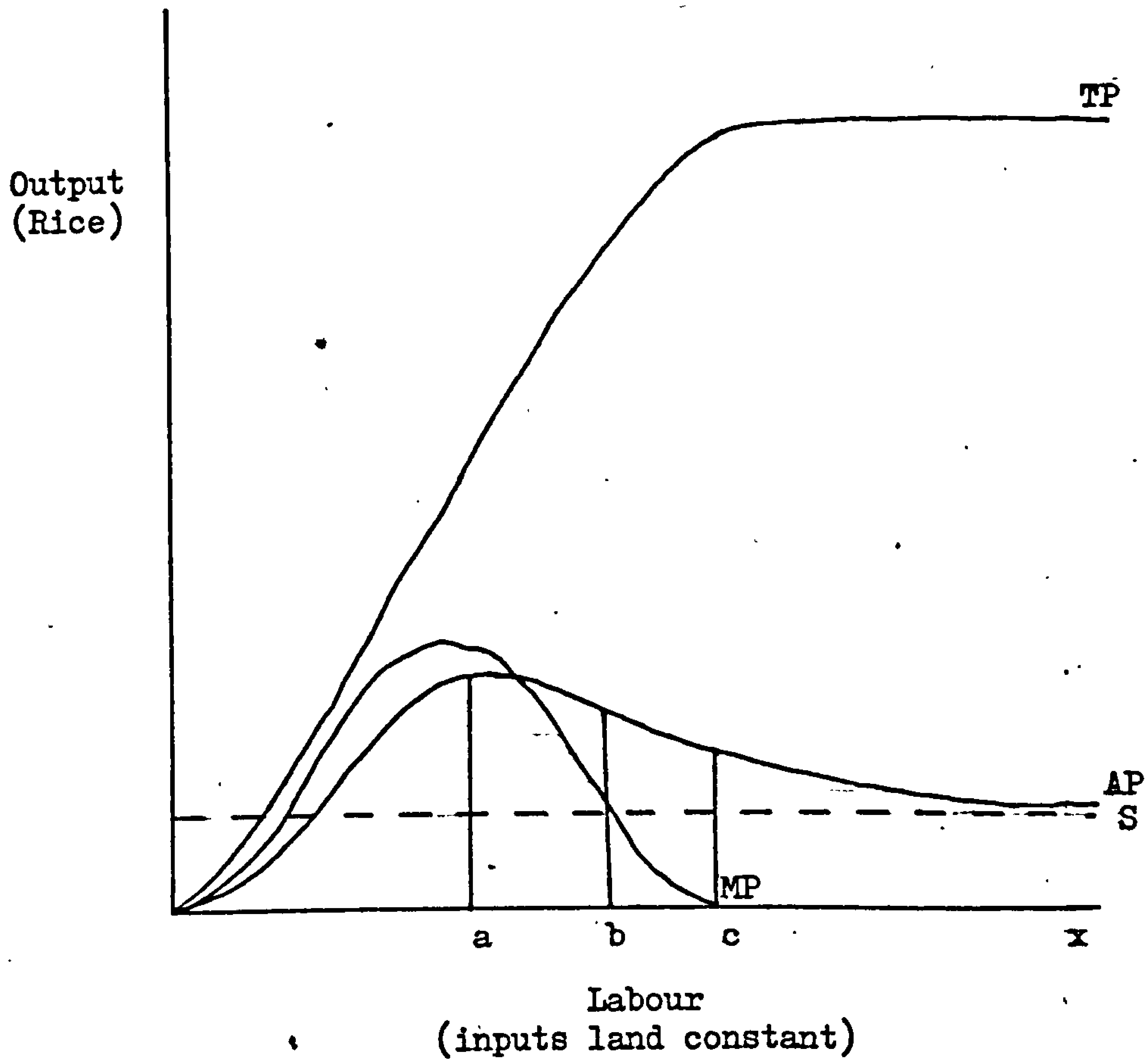
16. B. M. Shipley, "Soils" in Duncan Timms, op. cit., Part 1, Chapter 4, p. 66 and Fig. 4.1, p. 69.

with Bengal is the alluvial Carse clay. They form a thick sedimentary layer deposited by the sea on top of the original rock. Yet, although they are highly fertile, they account for only 56.25 square miles or 7% of the total land area[17].

Such differences in productivity between temperate and tropical soils have profound implications for agricultural development. Firstly, high fertility soils permitted much larger and denser populations. This is illustrated by the hypothetical production function for Bengal soils in Figure 1.8. On rich alluvial soils where yields are high, total product (TP) rises sharply with initial inputs of labour. Average product (AP) thus reaches a maximum (A) well above subsistence level. Hence, when marginal product (MP) reaches subsistence level at point B, average product is still above subsistence. Average product is defined as total product minus total input. Hence there is a surplus of food over requirements and population can grow. Even when marginal product equals zero at point C, further population growth is still possible because average product is still above subsistence. It is only when point X is reached and average product is at subsistence level that an equilibrium is enforced between food supply and population.

17. _ibid_, p. 44.

Figure 1.8
Hypothetical production function,
Bengal soils



TP = total product

AP = average product

MP = marginal product

S = subsistence

Secondly, the sharp <u>initial</u> increase in total output from fertile soils also means that the marginal product of labour is low. On less fertile soils where total output responds more slowly to an increase in labour inputs, the average product of labour may never rise above subsistence, but the marginal productivity of labour will be greater. In other words, the higher soil fertility, the bigger the returns to labour in the early stages of production but the smaller the return for each extra unit of labour[18]. The implications of this important difference in the marginal productivity of labour will become apparent in Chapter 6.

Thirdly, high fertility soils made innovation difficult. Earlier we noted the constraints on innovation imposed by topography and seasonal floods. It can also be argued that Bengal's environment of fertile soils and an extended growing season made it hard for man to improve on nature. After all, Bengal had three rice harvests a year. By contrast, Scotland's unfavourable environment of low fertility soils and cold climate left considerable scope for improvement. Marx was well aware of this difference:

18. John W. Mellor, "The Average and Marginal Product of Farm Labour in Underdeveloped Economies", <u>Journal of Farm Economics</u>, vol. XXXVIII, No. 3, (August, 1956), pp. 780-784.

> "It is not true that the most fruitful soil is most fitted for the growth of the capitalist mode of production. This mode is based on the dominion of man over nature. Where nature is too lavish, she keeps him in hand, like a child in leading strings. She does not impose on him any necessity to develop himself. It is not the tropics with their luxuriant vegetation, but the temperate zone, that is the Mother Country of Capital. It is not the mere fertility of the soil, but the differentiation of the soil, the variety of its natural products, the changes of the seasons, which form the physical basis for the social division of labour, and which, by changes in the natural surroundings, spur man on to the multiplication of his wants, his capabilities, his means and modes of labour. It is the necessity of bringing a natural force under the control of Society, of economising, of appropriating or subduing it on a large scale by the work of man's hand, that first plays the decisive part in the history of industry"[19].

Despite higher soil fertility, however, Bengal did not necessarily enjoy greater land productivity. The distinction is important. Fertility is determined by the quantity of plant nutrients in the soil. Land productivity, on the otherhand, is also the result of differences in climate, water supply and above all, the quality of human management. It is difficult to compare land productivity,

19. Karl Marx, Capital. A Critique of Political Economy. (Lawrence and Wishart, 1954), vol. 1. p. 481.

since yields per acre in Scotland in 1760 and Bengal in 1870 cannot be accurately quantified. European observers to Asia in the 18th century were astonished by the size of the rice yields they saw there[20]. Our comparison between Scotland and Bengal bears out this disparity. Accounts in the 1790's suggest that Scottish yields for oats and barley in 1760 were around 7.07 hl. per acre[21]. This may be compared with yields per acre in three of our four sample districts in Bengal before 1870:

Table 1.1

RICE YIELDS PER ACRE, BENGAL 1870

(hl/acre)

	DISTRICT	AMAN	AUS	BORO
(1)	Dacca	9.32	9.29	9.29
(2)	Jessore	12.12	9.32	10.25
(3)	Purnea	9.11	n.a.	a.a.
	Average	10.18	9.30	9.77

Sources:

(1) Baboo Radhakant Deb, "On the Culture of Paddy in Twenty Different Districts", Transactions of the Agricultural and Horticultural Society of India, vol. 2, Part LXXII, (1836), pp. 109-202.

20. Fernand Braudel, Capitalism and Material Life, 1400-1800, (Fontana, 1974), p.104.

21. Assuming an average seed rate of 1.585 hl/acre (1.24 hl/acre for barley, 1.93 hl/acre for oats), and a seed-yield ratio of 1:4.5. Handley, Agricultural Revolution, p.61. Sir John Sinclair, Analysis of the Statistical Account of Scotland, Part First (Edinburgh, 1825), p. 235 records seed/yield ratios of 1, 4 and 1,6.

Table 1.1 continued:

(2) J. Westland, A Report on the District of Jessore: its antiquities, its history and its commerce, (Calcutta, 1874, 2nd ed), Appendix 8, p. iii.

(3) "Rice Statistics for Bengal, Bihar and Orissa", Journal of the Agricultural and Horticultural Society of India, New Series, vol. II, Part I, No. 2 (1869-70), p. 181.

These figures show that rice yields in Bengal may have been as much as 30% higher than cereal yields in Scotland before the agricultural revolution. If so, attempts to increase land productivity in Bengal would have been much more difficult than in the Forth Valley, since Bengal agriculture started from a much higher base.

Comparative trends in land productivity, however, show that this difference was reversed. The increase in land productivity in western Europe has been documented by Slicher van Bath:

Table 1.2

SEED/YIELD RATIOS IN TEMPERATE NORTH SEA ZONE, 1500-1820

DATES	WHEAT	BARLEY	OATS	ALL GRAINS
1500-1549	6,6	-	4,4	5,9
1550-1559	8,7	6,4	3,8	6,7
1600-1649	7,9	5,3	2,9	6,2
1650-1699	7,0	-	-	7,0
1700-1749	-	-	-	-
1750-1799	9,5	10,0	8,8	9,7
1800-1820	9,6	12,7	12,0	11,3

Source: B. H. Slicher van Bath, "The Yields of Different Crops (Mainly Cereals) in Relation to the Seed c. 810-1820", <u>Acta Historiae Neerlandica</u>, vol. II, (Leiden, 1967), Tables 3a, c, d, f.

Note: The temperate north sea zone comprises England, Ireland, Belgium and the Netherlands.

Unfortunately, no series of yield ratios for Scotland is available. But records of a single farm in the Forth Valley provide yield ratios for wheat, barley, and oats for the years 1781-1795. The figures are shown in table 1.3.

Table 1.3

SEED/YIELD RATIOS, FORTH VALLEY, 1790
(hl/Scots acre)

CROP	SEED	YIELD	RATIO
Wheat	1.50	18.76	12,51
Barley	1.52	15.31	10,07
Oats	1.92	16.83	8,76

Source: J. F. Erskine, General View of the Agriculture of the County of Clackmannan... (Edinburgh, 1795), Appendix.

With the exception of wheat, these ratios compare closely with Slicher van Bath's: 8,7 for oats compared with 8,8 and 10,0 for barley in both cases. By 1790, therefore, Scottish yields were comparable with the best elsewhere and rose by some 25% between 1750 and 1820. The average yields reported for farm crops in the Forth Valley in 1790 are shown in Table 1.4:

Table 1.4

YIELDS IN THE FORTH VALLEY, 1790
(hl/acre)

CROP	CARSE	DRYFIELD
Wheat	10.62	9.02
Barley	12.06	10.25
Oats	11.94	10.14
Peas/beans	10.00	10.00
Hay	19.95	19.95
Turnips	-	-
Potatoes	50.80	50.80

Source: OSA, vols. IX, XII,

By contrast, yields in Bengal probably declined. When crop-cutting experiments began in 1892, the results showed a clear drop from the estimates before 1870. Reliable estimates only begin in 1913[22].

Table 1.5

FOODGRAINS YIELDS IN BENGAL, 1907-1922
(hl/acre)

DATES	AMAN	AUS	BORO	GRAM
1907/8-1911/12	6.35	4.96	7.41	4.15
1912/13-1916/17	6.31	5.68	7.00	3.70
1917/18-1921/22	6.21	5.64	6.79	3.37

Source: Quinquennial reports on crop-cutting experiments for the years cited.

22. Report of the Agricultural Department, Bengal, for the year 1913, Ch. 1, para. 3(4), p.2. Confusion has arisen over Indian measures of yield per acre because it is sometimes unclear from the studies in Farm Management in the 1950's, whether yields are in relation to sown or gross farm acreage. Since yield statistics for British India were collected from random plots over a wide area, not from farms, this danger does not arise. See Appendix C above, pp. 620-622.

These figures suggest a drop of over 50% in rice yields between the 1830's and 1914. In the absence of continuous data, it is impossible to tell whether this fall was real or merely a statistical mirage. Nevertheless, the trend in yields was almost certainly downwards , though the drop was less dramatic than the fragmentary statistics suggest. Complaints about reduced land productivity were common in the 1870's. "The soil appears to have decreased in productive powers by over-cropping; and it is said that the land now produces less by one-fifth than what it did twenty-five years ago"[23]. Like any other cereal, rice removes nutrients from the soil. One estimate puts the nutrient loss on a paddy crop of 12.7 hl. peracre at 31.16 kg nitrogen, 5.43 kg phosphoric acid, and 30.16 kg potash[24]. Clearly without careful management in the form of manuring, fallowing, or more intensive farming, continuous cropping with rice reduced soil fertility. By 1914, Bengal rice yields were only 20% above the aerobic equilibrium (5.26 hl/acre) whereby nutrient loss is replaced by nutrients supplied by water and sunshine[25]. Cereal yields in the Forth Valley were almost 70% higher.

23. W. W. Hunter, A Statistical Account of Bengal, (London, 1875), vol. VII, p. 390 (Dinajpur).

24. D. H. Grist, Rice, (London, 1959), p. 183.

25. Shigeru Ishikawa, Economic Development in Asian Perspective (Tokyo, 1967), p. 185.

For comparative purposes, the yields in Tables 1.4 and 1.5 were converted to calorific equivalents, and are shown in Table 1.5(a) below:

Table 1.5(a)

YIELDS IN BENGAL AND THE FORTH VALLEY

CROP	CARSE	DRYFIELD
Wheat	3171	2693
Barley	3826	3251
Oats	4270	3626
Peas/beans	2363	2363
Potatoes	3941	3941

	1907-12	1912-17	1917-22
Aman	2014	2001	1976
Aus	1573	1801	1789
Boro	2350	2220	2154
Gram	1110	989	901

Source: Tables 1.4 and 1.5.

Calorific equivalents for Forth Valley from Margaret E. Goldie, The Standard of Living of Scottish Farm Labourers in Selected Areas at the time of the first two Statistical Accounts (M.Sc Thesis, Edinburgh, 1970) p.109 Table 2, and for India from Ministry of Agriculture, Fisheries and Foods, Manual of Nutrition (London, 1976, HMSO).

Table 1.5(a) shows that, on average, oats yielded 3948 kcal per acre in 1790. By contrast boro, the highest yielding rice variety, yielded only 2241 kcals per acre. Cereal yields in the Forth Valley were thus about 70% higher than in Bengal.

With falling yields and no major additions to the cultivated area after 1870, agricultural output grew slowly. Table 1.6 shows that between 1890-1912 the rate of growth of foodgrains calculated using ordinary least squares was only .2% per annum. It is important to note that Bengal agriculture was not stagnant. Stagnation, which implies a zero rate of growth, must not be confused with poverty, which is the result of slow growth. Nevertheless , this was a lower rate of growth than in other regions of India and demands explanation.

Table 1.6

AGRICULTURAL OUTPUT IN BENGAL, 1890-1912

(000 maunds)

YEARS	FOODGRAINS	NON-FOODGRAINS	TOTAL
1890-91	359430	63228	422658
1891-92	316952	52314	369266
1892-93	366709	61173	427882
1893-94	416989	55548	472537
1894-95	469270	58943	528213
1895-96	372536	61866	434402
1896-97	244763	51871	296634
1897-98	446850	66803	513653
1898-99	489766	58112	547878
1899-1900	444933	56399	501332
1900-01	359968	62798	422766
1901-02	370344	68955	439299
1902-03	414276	58203	472479
1903-04	398663	65521	464184
1904-05	394205	62679	456884
1905-06	361938	64488	426426
1906-07	369219	67390	436609
1907-08	317341	69761	387102
1908-09	353541	47825	401366
1909-10	432289	51587	483876
1910-11	406565	55702	483876
1911-12	404946	60435	465381
OLS % p.a.	+0.214	+0.030	+0.193

Source: K. L. Datta, Report on the Enquiry into the Rise of Prices in India, (Calcutta, 1914), vol. 3, pp. 404-405.

<u>Section 2: changes in environment</u>

Land is not a fixed input. Soils and climate may change; they have a history. Geographers have argued - and some historians have echoed them - that such changes had strongly adverse effects on agricultural productivity in this period[26]. This section, therefore, compares the effect of changes in environment on agricultural output.

A delta by definition is not a stable environment: "what would be 'Delta' today would not be tomorrow"[27]. Instead, a delta represents an environmental cycle whereby soil is eroded from mountains which are slowly degraded, carried downstream by rivers and deposited on the flood-plain. As deposits accumulate, so the plain is gradually raised above flood level and stops receiving salt deposits. When the original floodplain has completely silted up the floods carry the alluvium further downstream to be deposited on a lower floodplain where the cycle begins again.

26. The geographers include Arthur Geddes, <u>The Human Geography of Bengal</u>, (Ph.D thesis, Edinburgh, 1935), and Charles A. Bentley, <u>Malaria and Agriculture in Bengal</u>, (Calcutta, 1925). The historians include George Blyn, <u>Agricultural Trends in India, 1891-1947. Output, Availability, and Productivity</u> (Philadelphia, 1966) pp. 197-200 and Arabinda Biswas, "The Decay of Irrigation and Cropping in West Bengal, 1850 to 1925. <u>Food Systems and Society Working Paper Series No. 2.</u> (UNRISD, Geneva 1979).

27. C. Strickland. <u>Deltaic Formation with Special Reference to the Hydrographic Processes of the Ganges and Brahmaputra</u>, (Calcutta, 1940), p. 5.

This cycle is clearly evident in Bengal. Erosion occurs in the Himalaya and areas of old alluvium which form the uplands ringing the delta. The area of alluvial soil which receives no fresh silt deposits is known as the paradelta. Alluvium was then carried down and deposited on the flood-plain or the delta proper. Changes in the level of the delta were a continual process and made more land available for cultivation.

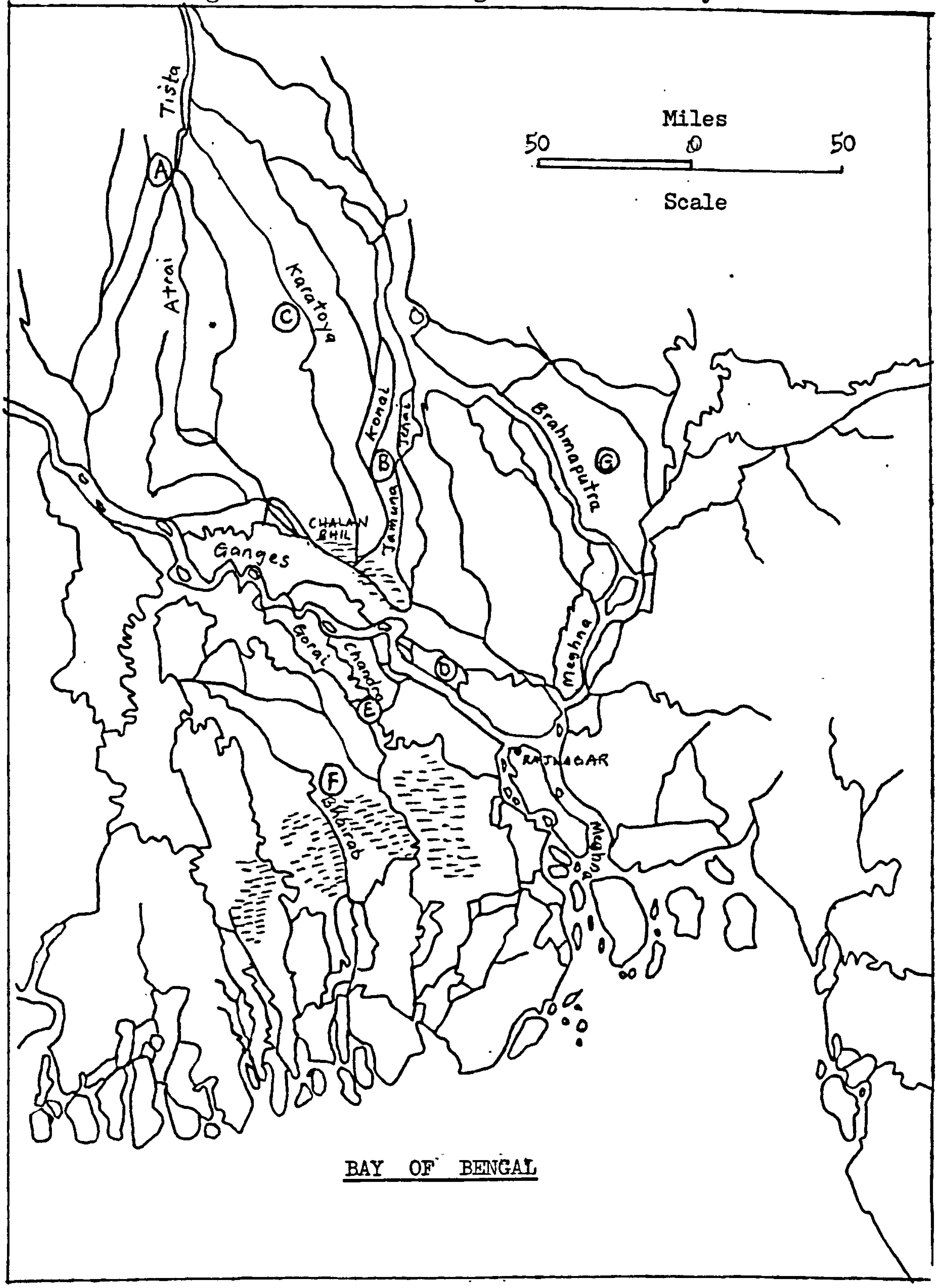
> "Bheels and swamps are gradually silting up by the action of rainwater, or water charged with deposits... Within the memory of man, many a Bheel or swamp, the haunt of waterfowl and fish, of coot and heron, has so risen as to be fitted for the plough..."[28]

What interrupted this otherwise benign cycle in Bengal was a change in the river system. Bengal has four such systems: the Ganges Padma, the Meghna, the Brahmaputra and the rivers of north Bengal (Tista, Atrai and Karatoya)[29]. A major change took place in these systems just six years after the Permanent Settlement, in 1787. (Figure 1-9).

28. W. S. Seton-Karr, "Agriculture in Lower Bengal", Journal of the Royal Society of Arts, vol. 31, (1883), p. 427.

29. Nafis Ahmad, Economic Geography of East Pakistan, (London, 1968, 2nd edn.), pl 12. We omit the river systems of the Chittagong Hill Tracts and adjoining plains.

Figure 1.9
Bengal environment: changes in the river systems



The map shows the river system according to earliest survey by Sir John Rennel between 1763-1777[30]. It shows the Tista in the north west corner as a sizeable river which divided above Dinajpur. In 1787 it flooded, and the resulting change in the norther rivers set off a chain reaction throughout all the river systems in the delta. Debris blocked the Tista at its confluence with the Atrai (Point A). Deflected east, the Tista joined two distributaries of the Brahmaputra, the Jenai and Konai (Point B). These are shown in Rennel's survey as separate streams, but by the survey of 1858, they had merged with the Jamuna. Meanwhile, the old distributaries of the Tista like the Karatoya shrank into insignificance. The increased size of the Jamuna now altered the course of the Ganges: it moved four miles north between the Jamuna and the Meghna (Point D). The reinforced Ganges then carved a new exit in the east, bypassing its old turn south at Rajnagar and carrying straight on to join the Meghna at Chandpur.

The most important change, however, was not in the Ganges but its distributaries. In 1774, the majority flowed south to flood the western half of the delta. Now some dried up. The Chandra in 1774 had been navigable all year round, but by 1858 it was almost dry in winter

30. Rennel's surveys, "are so accurate, that they can be replotted on a modern map". Arthur Geddes, _op. cit._, vol. 1, C. 33.

(Point E). The Bhairab suffered a similar fate: the fertile marshes shown on Rennel's map had shrunk to half their size by 1858. (Point F). The change in northern Bengal was equally great. The headwaters of the Brahmaputra, which Rennel had described as the same size as the Ganges, were captured by the Tista and the river slowly silted up. (Point G)[31].

The Permanent Settlement thus coincided with environmental change on a massive scale (Figure 1-10). Not only did the deflection of the Tista cost western Bengal much of its floodwater, but the Ganges distributaries lost much of their strength. According to one geographer, the results were disastrous. "This river change has altered Western and Central Bengal out of recognition with the last hundred years, disastrously checking fertility, food sufficiency, health and population in the west and south, and giving all the flood irrigation, soil fertility, health and prosperity to the east"[32].

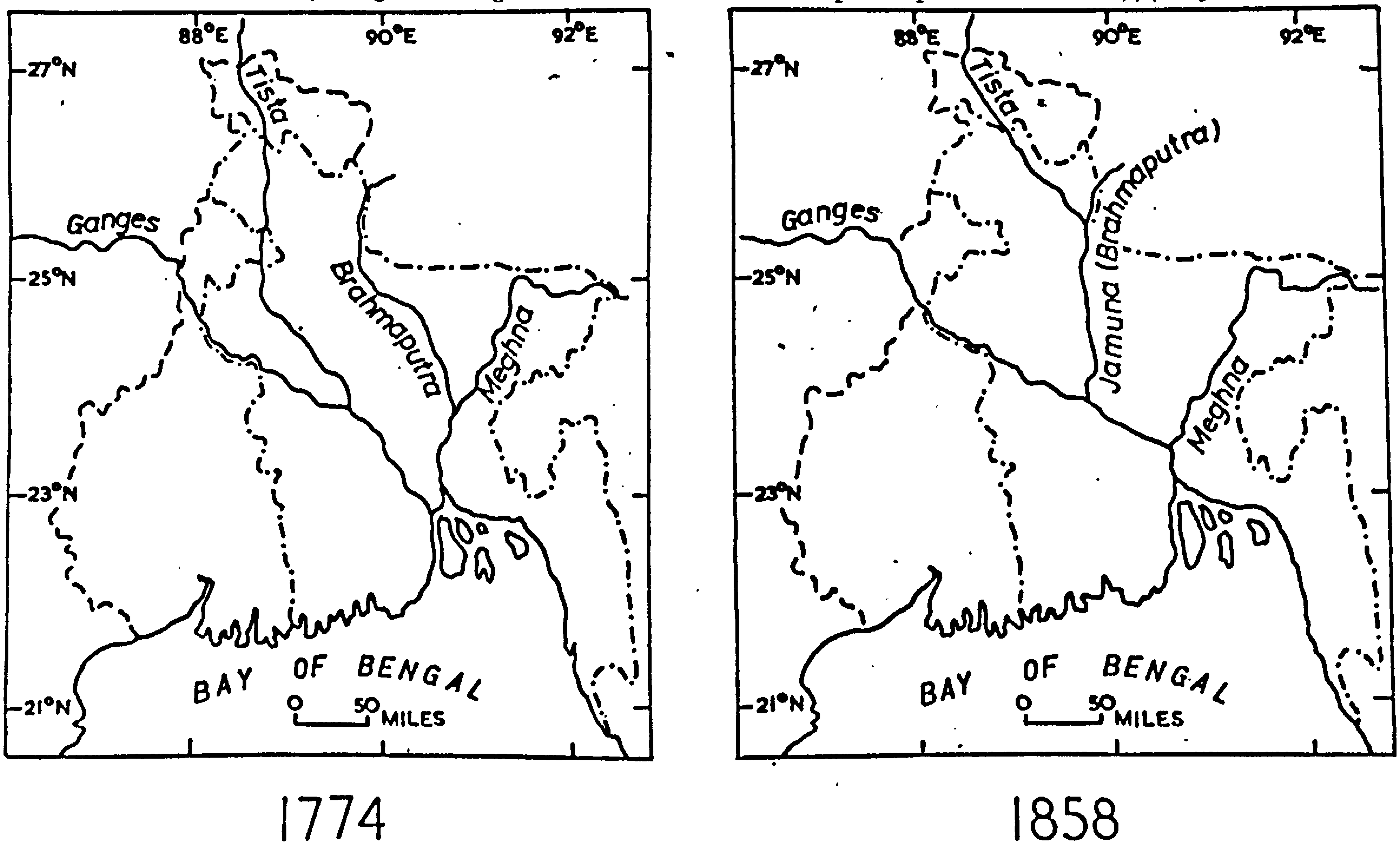
This natural change in the river system was compounded by the construction of artificial river and railway embankments which prevented floods and blocked natural

31. The fullest account is in Bilquis Jahan, Some aspects of the historical geography of East Pakistan, 1608-1857, (Ph D Thesis, London, 1969), pp. 18-35.

32. Arthur Geddes. The Human Geography of Bengal, (Ph.D Thesis. Edinburgh 1935), vol. 1, C16.

Figure 1.10

Environment, Bengal: changes in the courses of the principal rivers c. 1774–1858



drainage channels. A case study of this process has been made for the area between the Damodar and Hooghly rivers in West Bengal[33]. This area was originally irrigated by seven overflow channels, six of which issued from the river Damodar. By 1850, 5 had fallen into disuse because of poor maintenance by zamindars, but the Kana Nadi and the Kana Damodar still irrigated some 145750 hectares. In 1863, however, a metalled road was built between Memari and Chadhiki and the left bank of the Damodar was strengthened to protect the railway. This killed the two remaining channels and effectively sealed off the region from floods. What nature began, man completed.

Similar processes occurred elsewhere. The effects are seen in Table 1.7 which shows the connection between the increase in the road and railway network and the increase in land left fallow.

33. Arabinda Biswas and Swapan Bardhan, "Agrarian Crisis in Damodar-Bhagirathi Region 1850-1925". Geographical Review of India, vol. 37, No. 2., (June, 1975), pp. 132-150.

Table 1.7

COMMUNICATIONS AND FALLOW AREA, BENGAL, 1914

(%)

REGION	(I)	(2)
West Bengal	21.42	1637.82
Central Bengal	40.69	1562.24
North Bengal	20.70	1640.75
East Bengal	4.08	2717.13

Source: reworked from C. A. Bentley, *Malaria and Agriculture in Bengal*, (Calcutta, 1922), pp. 30-34.

Notes : (I) % of fallow to cultivated area

(2) Number cultivated acres per mile of rail and metalled road

A regression analysis of the percentage of cultivated land left fallow and the number of cultivated acres per mile of rail and road shows an inverse correlation co-efficient (r^2 = -.824). For four samples this is equivalent to an 80% correlation.

Yet, however dramatic the environmental changes were, and however impressive the correlations, it is possible to exaggerate the effect on agricultural productivity. Bentley argued that yields were lower because the land was no longer fertilised by annual flooding;

"In villages adjacent to the Damodar, cultivators say that their land when irrigated with river

> water yields 12 maunds of paddy per bigha, whereas when cultivated with rainwater alone the crop is only 7 maunds"[34].

This is equivalent to a fall in yields of 30%. But while some regions of Bengal were admittedly no longer flood areas, silt was diverted elsewhere and other regions would, therefore, have benefitted. The net effect was thus indeterminate. Secondly, silt was not necessarily the key factor in high rice yields. Bentley claimed that "The fertility of Eastern Bengal... is almost wholly due to the inundations with silt-bearing river water which these delta tracts now enjoy"[35]. Yet modern soil scientists now believe otherwise. It is reported from Dacca district that "Only near the Dhaleswari and Padma rivers is there an appreciable silt deposit by the annual floods. Fertility in these soils is now believed to be provided by the release of nutrients from weathering of minerals in the original alluvial deposits"[36]

34. Charles A. Bentley, <u>op. cit.</u>, p. 45.

35. <u>ibid</u>, p. 57.

36. S. N. H. Rizvi (ed). <u>Dacca</u>. <u>East Pakistan District Gazetteers</u>, (Dacca, 1969), p. 124.

Silt from river floods is deposited over a relatively small area:

> Most floodplain areas are not flooded by river water. This results from the fact that the period of high river flood levels coincides with the period of heavy monsoon rainfall. In most areas, this rainfall is not able to penetrate into the soils because of impervious layers or because the water table rises above the ground surface. At the same time, drainage of this water from the land is impeded by the high level of the water from higher areas upstream. The water thus backs up over the floodplain land adjoining the rivers, the depth of flooding depending on the difference in elevation of the land... River flooding affects the width adjoining the major rivers... Soils receiving significant amounts of alluvial sediments from annual flooding are restricted to relatively narrow belts adjoining the major rivers and their distributaries[37].

Finally, the area known to have suffered a fall in soil fertility was relatively small:

> "There are about 2.108,173 acres of cultivable land in the present districts of Burdwan, Hooghly and Howrah. Of this, probably not less than half lie within the area that used at one time to be

37. Soil Survey Project, Bangladesh. Soil Resources, (F.A.O., Rome, 1977), AGL:SF/PAK6, Technical Report 3, p. 26.

naturally irrigated with the flood water of the Damodar..."[38].

Another estimate puts the area affected at 1075450 acres, but makes no estimate of the loss to production caused by a decline in soil fertility[39]. Bentley estimated the loss at between 4.5-9 million maunds of rice. This was equivalent to less than 2% of total foodgrain production in 1914 (Table 1.6). An alternative accounting method is to estimate production lost through the increase in current fallows. The area left fallow rose by 1680.66 thousand acres between 1890-3 and 1909-12 (Table 1.15 below). This was equivalent to a loss in output of 23478.82 maunds or 4.99% of total output. By 1909-12, about 11% of total output was lost by land left fallow. This was considerable, but less serious than has often been claimed.

The same may be said for malaria. "Burdwan fever" as it came to be known first struck in Jessore in 1847-48 and raged as an epidemic throughout South and West Bengal till the 1870's; thereafter, it remained endemic. It is clear that the disease was associated with the change in the river systems. In the moribund delta, the rivers no

38. Charles A. Bentley, op. cit., p. 45.

39. Biswas and Bardhan, op. cit., pp. 134, 139.

longer flooded in summer. The stagnant channels and irrigation tanks provided an ideal breeding ground for the insect vector, the mosquito A. philippensis. By constrast, in eastern Bengal regular flushing by the rivers during the annual floods prevented the larvae breeding. The concentration of the disease in certain areas (Figure 1.11) might, therefore, have affected agricultural output by reducing the available labour supply.

It was estimated that each cultivator lost 60-90 days each year through malaria[40]. Since the average working year was approximately 240-260 days, this represented an average of 30% of the working year (Chapter 3, Section 1 above). According to Bentley, the number of people infected by malaria in Bengal in 1928 was 33 million[41]. Although not all were employed in agriculture, the effect on labour supply was presumably considerable, especially since rampant infection between September and March coincided with the busiest period of the agricultural calendar, the aman harvest[42]. Complaints about labour shortage in malarial areas during seasonal peaks were common:

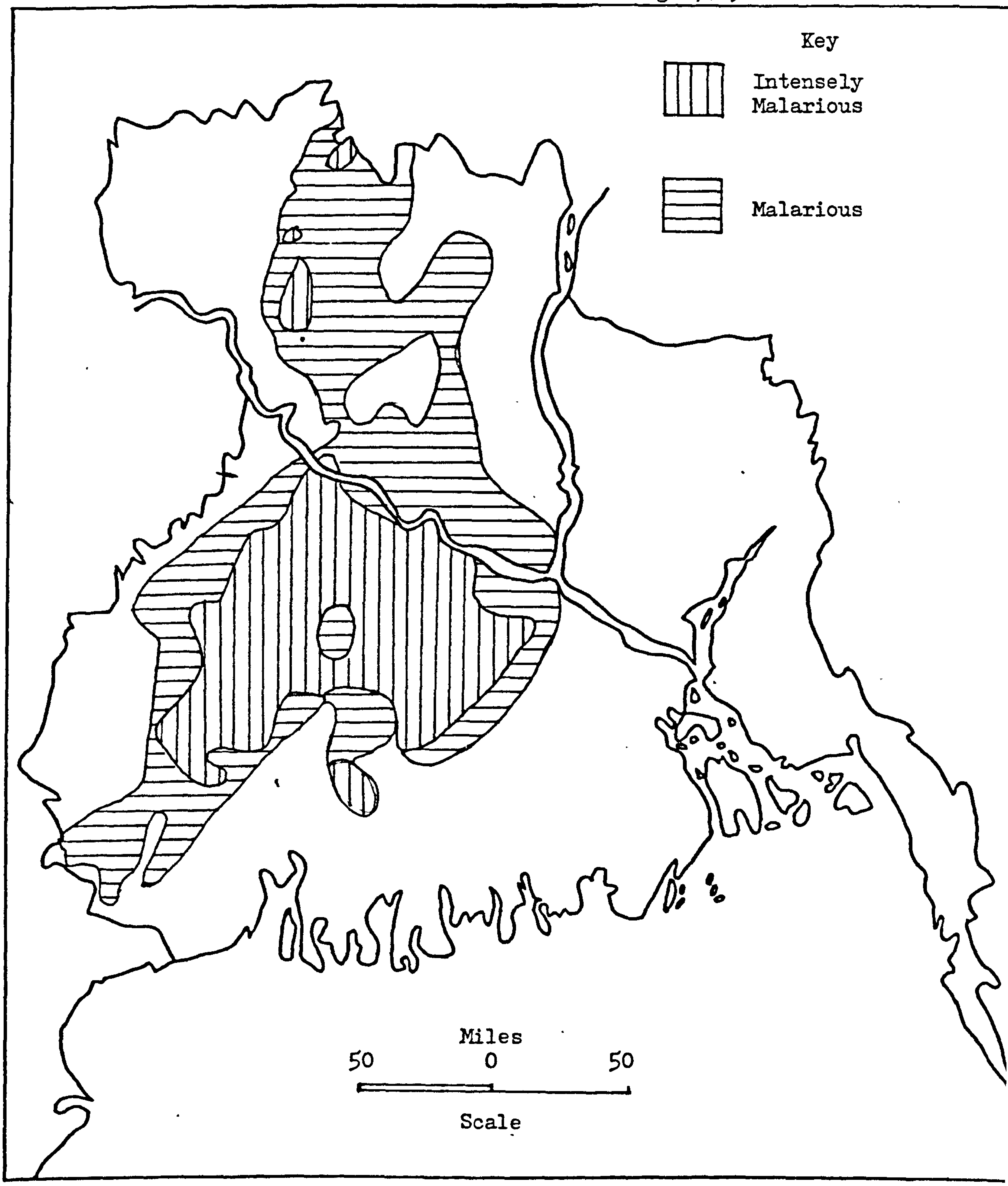
40. Royal Commission on Agriculture in India, (Bombay, 1927), vol. IV, Evidence taken in the Bengal Presidency. p. 351, question 17.

41. ibid, p. 261, question 21330.

42. ibid, p. 544, question 24258. See Figures 3.7, 3.8 above.

Figure 1.11

Distribution of Malaria in Bengal, 1916



"Families which were full of robust, working heads and could very well spare many of them from their own fields to work for others, can now scarcely supply labour adequate to cultivate their own lands"[43].

Yet once again the effect of environmental change on labour supply can be exaggerated. Our analysis of labour inputs to Bengal agriculture (Chapter 3, Section 3 above) shows that if there were any reduction in labour supply between 1890-1914, it occurred in the malaria free zone, the North and East. By contrast, labour inputs to agriculture in the area worst affected by malaria, the South and West, actually rose. It seems likely either that estimates of the numbers infected are inflated or that the extent of surplus labour in Bengal was large enough to absorb a reduction in labour supply without any fall in production.

Even in the areas most affected by changes in environment, physical factors alone cannot explain agricultural stagnation. Significantly, Bentley's report

43. Bengal General Proceedings, (Statistics, Head No. 1), September 1875, Colln. 4-7/8. Report of R. C. Mukerji, Deputy Magistrate on Special Duty in connection with the Fever Enquiry, 28 February 1874, para. 14, quoted B. B. Chandhuri, "Agricultural Production in Bengal, 1850-1900. Coexistence of Decline and Growth", Bengal Past and Present, vol. (July-December 1969), p. 163.

on _Malaria and Agriculture in Bengal_ was subtitled _How to Reduce Malaria by Irrigation_. The decrease in net cropped area and increase in current fallows might have been reversed by controlling water supply. Yet west Bengal already possessed an extensive network of irrigation tanks. By 1914, however, most of them were no longer effective: "many of them have silted up to such an extent that they have turned into actual rice fields, while others do not hold enough water for two or three acres in time of need". The blame for the failure to maintain the irrigation system was laid squarely on social, not environmental factors:

> "Now the question may naturally arise why the cultivators do not look after the tanks wherein their vital interest lies? But the fact is that, whereas each tank was meant to command a certain area which was originally leased out to one or two persons, the tank forming a part of the holding (_jama_) or holdings, portions of holdings are always being transferred from hand to hand without reference to the rights in the tanks. At present, it is not unusual to find that a tank may belong to a person who may have very little land in its influence; and holdings have been so much divided and subdivided that it is not at all impossible to find fifteen or twenty or more persons having land within the area commanded by a single tank. Now under the present state of things, the members of a village community are so poor and so divided into factions that it is extremely hard to get anything done by them. The owners of the lands say why should they go to

> renovate a tank the benefit of which would be enjoyed by others. These persons can hardly be expected to cooperate"[44].

But on closer inspection, the claim that subdivision of estates was primarily responsible for the decay of irrigation seems mistaken. Rather it appears that with the commercialisation of agriculture, tanks had ceased to be a communal resource. This the raiyats refused to accept, not through poverty but through the inertia of custom. The necessary labour for excavating tanks might easily have been supplied by the raiyats themselves:

> "Constantly on my tours I have received complaints about the village tanks. In every case, the cry was the same that Government should clean them. In all villages, there was an ample supply of local labour for the work but my suggestion that they sould apply the principle of self-help and clean their own tanks for their own benefit were not met with any enthusiasm..."[45].

Even self-interest was disregarded. The Collector of Burdwan reported that "The cost of re-excavation would generally be repaid in the improvement of the crop in the

44. Bhutnath Sarkar, "Irrigation Tanks in The District of Burdwan", Agricultural Journal of India, vol. XIV (1919), pp. 589, 592-3.

45. A. B. Fry, First Report on Malaria in Bengal, (Calcutta, 1912), p. 23.

first year of short rainfall in September and October"[46]. Yet raiyats deliberately chose to risk infection from malaria and harvest failure rather than pay for irrigation. The consequences for production were serious, for the aman crop since "rainfall is frequently insufficient at the time of transplanation and ripening... and if the existing tanks were in good order they could... hold enough water to be of immense value to the crop". Such attitudes, therefore, explain much of the decline in agricultural productivity in Bengal.

The second source of environmental change lay in climate. Agriculture in India is often described as a "gamble on the rains". Given agriculture's dependence on the monsoon, a secular change in the pattern of monsoon rainfall would have had a considerable impact on productivity. Meteorological studies have found no evidence of a secular decline in monsoon rainfall[47]. Nevertheless, this does not exclude the possibility of rainfall cycles. Such cycles if they exist will correspond to the eleven-year sunspot cycle[48]. To test the existence of rainfall

46. Proceedings 2nd Annual Conference of Board of Agricultural Department, Bengal, Dacca 1-2 August 1921, (Calcutta, 1921), Appendix II, Subject 4 - Irrigation Tanks p. xi.

47. S. K. Pramanik and P. Jagannathan, "Climatic Change in India. Part 1, Rainfall", Indian Journal of Meteorology and Geophysics, vol. 4, No. 4, (Oct, 1953), pp. 291-309.

48. R.K Mukherji, "Agricultural Cycles and Sunspots", Indian Journal of Economics, vol. X, No. 2 (1929), pp. 259-299.

cycles, 11-year running means were computed for monsoon rainfall in Bengal between 1830-1920. The results are shown in Figure 1.12. Despite wide annual percentage fluctuations around the mean, monsoon rainfall in Bengal was clearly cyclical. Four cycles may be tentatively identified. Two early cycles between 1840-1875 (peaking in 1848 and 1867) were associated with heavier than average monsoons. Two later cycles between 1875-1910 were associated with lower than average monsoon rainfall. This long period of subnormal rainfall is remarkable. Other areas of India also suffered deficient rainfall in a similar period. In Central India, for example, the years 1895-1921 were very dry, with rainfall below average in 22 years out of 27[49].

Similar climatic cycles may be observed in Scotland. Here the parameters for agriculture included temperature as well as rainfall. Their influence is clearly seen in fluctuations in harvest dates. We are fortunate to have such a series of harvest dates for central Scotland. The series gives both the starting and finishing dates of the grain harvest at Crofthead farm, west Lothian, between 1744-1839[50]. The dates recorded correspond well with those

49. K. S. Agarwala, "Fluctuations of annual rainfall in Central India (1872-1947)", Indian Journal of Meteorology and Geophysics, vol. 3, (1952), p. 229.

50. John B. Fleming, Crofthead Corn Harvest Notebook. A Study, (Edinburgh B.Sc. dissertation, 1977, Economic History), Fig. 8.

% deviation from normal
Monsoon rainfall cycles in Bengal 1830-1920 (11 year running means)
+50
+45
+40
+35
+30
+25
+20
+15
+10
+5
-5
-10
-15
-20
-25
-30
-35
1840
1850
1860
1870
1880
1890
1900
1910
years

Figure 1.12

% deviation from normal
Harvest dates in West Lothian, 1760-1839 (11 year running means)
+70
+60
+50
+40
+30
+20
+10
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
1770
1780
1790
1800
1810
1820
1830
1840

Figure 1.12


% deviation
from normal
Harvest dates in West Lothian, 1760-1839 (11 year running means)
+70
+60
+50
+40
+30
+20
+10
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
1770
1780
1790
1800
1810
1820
1830
1840

Figure 1.13

for the same period in the Forth Valley. (See Appendix A).

Once again, 11-year means were computed to test the existence of cycles. The results are shown in Figure 1.13. Four cycles may be identified during the period 1760-1840. The first cycle between 1760-1780 was associated with early harvests, as was the fourth cycle between 1820-1840. But both the second and third cycles (1780-1800, 1800-1820) were associated with late harvests. These cycles are closely correlated with short-term climatic fluctuations. Vine harvest dates in northern France, for example, are closely connected with changes in temperature[51]. Cereal harvest dates, however, depend on a greater variety of climatic factors - autumn rainfall, for instance, which determines the date of sowing - and are therefore more difficult to explain.

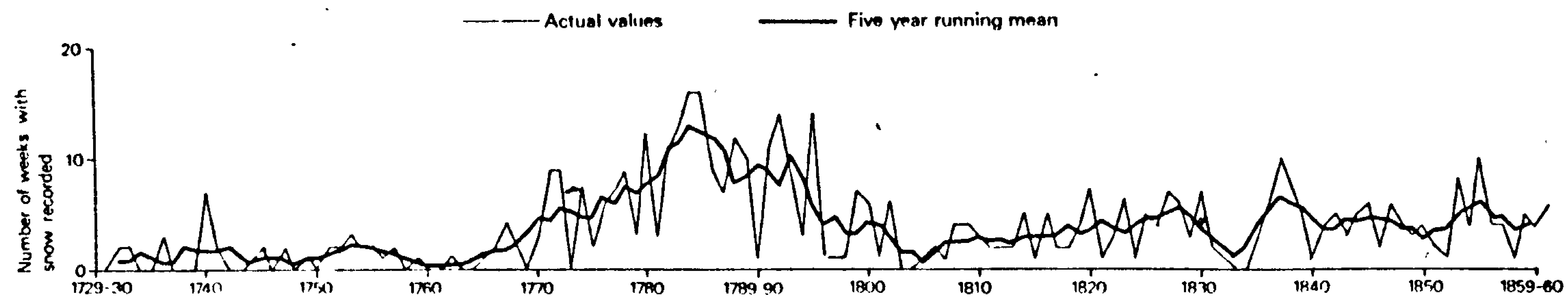
Two possible causes were examined: colder temperatures and higher rainfall. Evidence of colder temperatures is provided both by newspaper reports and meteorological data. (Figure 1.14) (See Appendix B). Interestingly, there is a close agreement between the two sources, which suggests that qualitative evidence on climatic change is more reliable than some historians suppose.

51. E. L. Ladurie, <u>Times of Feast, Times of Famine. A History of Climate since the Year 1000</u>, (London 1972), p. 265, Fig. 2.

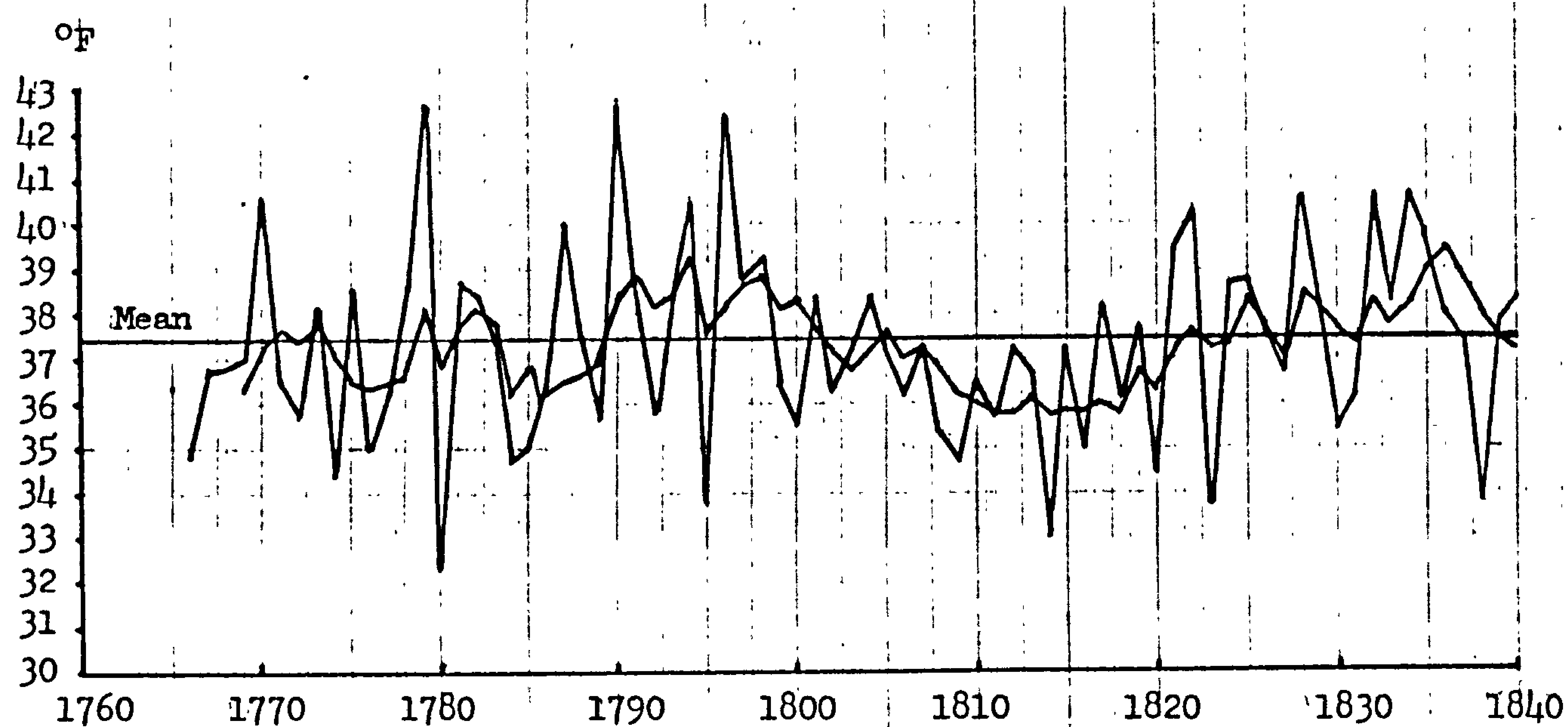
Figure 1.14

Environment: the Forth Valley

Number of weeks in each winter with reports of snowstorms, 1729-30 to 1859-60



Winter temperatures in Edinburgh 1765-1840 (5 year running means)



We might expect that harvest dates on an upland farm like Crofthead would be closely correlated with winter temperatures. Certainly the second cycle of late harvests between 1780-1800 is associated with winter temperatures above the mean and with very severe snowstorms. On the other hand, the third cycle of late harvests is associated with a decline in the frequency of snowstorms but a fall in winter temperatures. The period 1820-40 when harvests were early, is associated with both a low frequency of snowstorms and warmer winters. A regression analysis of harvest dates and winter temperature showed no significant correlation. By contrast, a regression analysis of harvest dates and summer rainfall between 1790-1839 showed a stronger positive correlation (r^2 = .351). A correlation coefficient of .351 for 40 samples is equivalent to a correlation of between 95-99%. Hence, wet summers in Scotland meant late harvests.

Table 1.8

HARVEST DATES, SUMMER RAINFALL, WINTER TEMPERATURES IN SCOTLAND, 1790 - 1839.

	(1)	(2)	(3)		(1)	(2)	(3)
DATE	HARVEST	RAIN	TEMPS	DATE	HARVEST	RAINFALL	TEMPS
1790	64	8.05	42.7	1820	46	7.40	34.6
1	58	7.31	38.7	21	48	3.59	39.5
2	63	12.62	35.8	22	37	8.25	40.2
3	58	5.12	38.4	23	71	9.12	33.9
4	33	5.03	40.6	24	44	5.09	38.7
5	53	9.96	33.9	25	29	4.09	38.8
6	54	4.25	42.4	26	1	4.44	37.5
7	55	11.87	38.8	27	45	8.78	36.8
8	31	7.62	39.1	28	36	8.81	40.6
1799	49	9.13	36.4	1829	44	13.31	38.1
1800	41	2.19	35.6	1830	57	15.80	35.4
1	38	6.33	38.4	31	26	7.88	36.2
2	66	8.53	36.2	32	45	7.67	40.5
3	50	4.21	37.1	33	37	6.17	38.3
4	48	7.09	38.4	34	26	5.83	40.7
5	52	5.69	37.4	35	35	4.38	39.9
6	46	5.59	36.2	36	69	11.48	38.0
7	58	4.48	37.3	37	39	11.53	37.6
8	37	12.61	35.3	38	67	10.58	33.8
1809	53	10.93	34.8	1839	48	9.19	37.9
1810	62	8.88	36.5				
11	51	8.57	35.7				
12	72	6.98	37.2				
13	57	4.88	36.7				
14	56	6.23	33.0				
15	55	5.84	37.2				
16	87	9.39	35.0				
17	68	13.90	38.1				
18	44	6.10	36.1				
1819	35	5.05	37.7				

Sources: (1) Reworked from John B. Fleming, Crofthead Corn Harvest Notebook: A Study (Edinburgh, M.A. dissertation, Economic History 1977), Figure No. 8, Part II.
(2), (3) Robert C. Mossman, "The Meteorology of Edinburgh" Transactions of the Royal Society of Edinburgh, vol. 39, (1896-97), No. VI, Table XXIX, pp. 143-4. Statistics reprinted in A. B. Thompson, Mean Winter Temperatures in Edinburgh 1764/5-1962/3, Meteorological Office Climatological Memoranda, No. 41, (London, 1964), Table 1.

Table 1.8 continued:

*Reprinted in Henry Helm Clayton, World Weather Records, (Washington, 1927-1947), Smithsonian Miscellaneous Collections, vol. 90, pp. 514-5.

Notes:

(1) Harvest dates 1 = August 4th (1826).

(2) "Summer" = June, July, August.

Yet although the existence of climatic cycles in Bengal and the Forth Valley seems beyond dispute, their impact on agriculture is difficult to determine. Certainly the frequency of low monsoon rainfall between 1875-1910 was associated with food shortages and famines in India. But although Bengal experienced droughts in 1884, 1896 1900, she escaped the mortality crises of 1896-7 and 1899-1900[52]. Her heavy rainfall ensured that annual fluctuations around the mean had a less drastic effect on production than in drier areas like Central India. Thus while Bengal had only five years of abnormal rainfall, (twice the mean deviation) between 1875-1940, Bombay had eight, Punjab had 14 and Bihar had 15[53]. Similarly, there is no correlation between rainfall in the sowing season and net cropped area. A regression analysis of

52. Catherine A. Gill, Famine in India, 1896-1900, (Glasgow M.A. dissertation, 1979 Economic History).

53. L. A. Ramdas, "Rainfall and Agriculture: Use of Routine Rainfall Reports for Crop Outlooks." Indian Journal of Meteorology and Geophysics, vol. 1, Pt. 14, (Oct., 1950), p. 265, Fig. 2.

of these two variables in Bengal between 1890-1912 showed no significant correlation (r^2 = .134). (See Table 1.15 column 5 above).

Finally, there is no correlation between monsoon rainfall and price fluctuations. Hussein's comparison of annual rainfall and prices in Bengal between 1861-1895 revealed that "price indices were not inflated in years of deficiency or of excessive rainfall except on a few occasions"[54]. Similarly, a regression analysis of monsoon rainfall and rice prices in Bengal between 1870 and 1914 showed no significant correlation (r^2 = -0.035). (Table 1.9)

By contrast, there was a close relationship between climate and prices in Scotland. Mossman's pioneering work shows that between 1764 (when temperature series begin) and the 1860's there is "a close connection" between mean annual temperature in Edinburgh and wheat prices at Haddington[55]. A regression analysis of harvest dates and oats prices between 1760-1799 showed a strong positive relationship (r^2 = .336). For 40 samples, this represents a correlation of 95-99%. (Table 1.1).

54. A.S M.A. Hussein. A Quantitative study of price movein Bengal during the 18th and 19th centuries, (Ph.D, SOAS 1977), p. 186

55. Robert C. Mossman, "On the price of wheat at Haddington from 1627-1897". The Accountants Magazine, vol. IV, (Jan-Dec 1900), p. 100. There was no long term correlation between prices and climate in Scotland or in western Europe. Ladurie, Times of Feast, Times of Famine, p. 279.

Table 1.9

BENGAL MONSOON RAINFALL AND RICE PRICES, 1870-1914

	(1) PRICE (RS)	(2) RAIN (11)
1820	1.74	52.85
1	1.67	70.35
2	1.69	43.87
3	1.97	37.51
4	2.86	52.35
5	2.13	49.2
6	2.01	69.62
7	2.33	47.34
8	3.24	39.31
1879	3.21	39.67
1880	2.09	59.01
1	1.55	56.4
2	1.64	54.2
3	2.07	42.22
4	2.69	54.99
5	2.67	56.82
6	2.23	53.64
7	1.94	47.03
8	2.04	54.01
1889	2.76	45.89
1890	2.66	53.8
1	2.60	36.85
2	3.31	38.95
3	3.48	61.07
4	3.13	37.32
5	2.52	35.01
6	3.29	48.57
7	4.37	50.72
8	3.09	54.06
1899	2.46	59.27
1900	3.01	81.48
1	3.68	56.21
2	3.34	44.76
3	3.08	49.26
4	3.92	47.68
5	3.21	48.73
6	4.55	41.01
7	5.14	42.27
8	4.73	75.02
1909	4.19	60.8

	(2) RAIN (11)	(1) PRICE (RS)
1910	48.44	3.48
11	35.77	3.59
12	41.35	3.99
13	71.34	5.11
14	43.01	5.37

r^2: -0.035

Sources: (1) A. S. M. A. Hussein, <u>A Quantitative study of price movements in Bengal during the 18th and 19th centuries</u>. (Ph.D. thesis, SOAS, 1977), Tables A.4, A.96.

(2) Henry Helm Clayton, <u>World Weather Records</u>, (Washington, 1927-47). Smithsonian Miscellaneous Collections, vol. 79, pp. 243-244.

Note: June-October rainfall.

Table 1.10

HARVEST DATES AND OATS PRICES, 1760-1840

DATE	(1) HARVEST	(2) PRICE	DATE	(1) HARVEST	(2) PRICE
1760	37	9.83	1800	41	48.97
1	38	10.97	1	38	23.79
2	29	20.60	2	66	21.04
3	40	13.93	3	50	23.22
4	48	16.68	4	48	27.0
5	34	19.66	5	52	26.87
6	43	19.43	6	46	30.66
7	50	18.77	7	58	36.91
8	33	13.27	8	37	34.77
1769	46	15.10	1809	53	31.81
1770	55	15.56	1810	62	28.33
1	62	18.54	11	51	33.41
2	60	19.45	12	72	50.81
3	36	18.87	13	57	30.20
4	62	18.37	14	56	27.35
5	35	13.95	15	55	22.41
6	46	13.83	16	87	40.27
7	61	15.79	17	68	36.04
8	57	15.56	18	44	35.25
1779	20	12.58	1819	35	24.47
1780	37	15.79	1820	46	23.0
1	26	13.72	1	48	23.58
2	74	24.35	2	37	19.91
3	50	18.77	3	71	27.22
4	73	19.53	4	44	25.75
5	37	15.20	5	29	28.50
6	50	18.77	6	1	37.10
7	59	18.29	7	45	24.35
8	43	13.83	8	36	26.33
1789	51	18.08	1829	44	23.00
1790	64	19.56	1830	57	26.91
1	58	17.85	1	26	24.33
2	63	19.10	2	65	19.83
3	58	20.68	3	37	19.08
4	33	20.35	4	26	20.91
5	53	26.66	5	35	21.08
6	54	20.47	6	69	23.00
7	55	17.85	7	39	23.00
8	31	19.22	8	67	22.33
1799	49	39.15	1839	48	25.83

$r^2 = 0.336$ $r^2 = 0.144$

Table 1.10 continued:

Sources : (1) Reworked from J. B. Fleming. Crofthead Corn Harvest Notebook. A Study. (Edinburgh B.Sc. dissertation, 1977, Economic History), Fig. 8. See Appendix B above.

(2) Haddington Fiars prices from J. L. Symon, Scottish Farming Past and Present, (Edinburgh, 1959). Appendix 3, pp. 456-457.

Notes: (1) Harvest dates on scale 1 = 4 August (1826).

(2) Oats shillings per imperial quarter.

Bengal cannot, therefore, be singled out as uniquely sensitive to climatic fluctuations. In any case, the explanations for such fluctuations are not local but global. Both the timing and the extent of the monsoon are controlled by the general circulation of the planet, the name given to two sets of planetary winds. Of these, the most important are the upper westerlies whose polar vortex contracts the upper westerlies stay in middle latitudes and the result is high rainfall. When the polar vortex expands, the upper westerlies move down to southern latitudes and the result is low rainfall[56]. Rainfall in both Asia and Europe is, therefore, controlled by the same mechanism. There is, for example, a positive correlation between the secular trend in summer rainfall in north India and in Eng-

56. Pierre Pedalaborde, The Monsoon, Trans. M A. Clegg. (London, 1963), p.

land[57]. Hence, to be convincing, climatic explanations must be universal and cannot be invoked to explain development in one region and stagnation in another.

In sum, therefore, there is no evidence to suggest that agricultural stagnation in Bengal may be explained by climatic change. The most significant climatic change during our period was a cyclical fall in monsoon rainfall between 1875-1910, but this was shown to have had no connection with changes in the net cropped area or rice prices. By contrast, climatic cycles in the Forth Valley can be shown to have affected production. Later harvests between 1780-1820 as a result of colder temperatures and heavier summer rainfall had some impact on agricultural prices. Yet, this was the very period in which Scotland experienced an agricultural revolution. The impact of climate on agricultural development may, therefore, be exaggerated. Scottish farmers were not helpless victims of climatic change. Indeed, "the role of an increasingly severe winter climate in the latter 18th century was to give a stimulus to the more widespread adoption of agricultural improvements"[58].

57. Derek Winstanley, "Rainfall Patterns and General Atmospheric Circulation", Nature, vol. 245, Sept., 28 28, 1973, p. 192, Fig. 5.

58. J. B. Moncrieff, Climatic Limits to Cultivation in the Ochil Hills, (Edinburgh B.Sc. dissertation, 1978, Geography). P. 63. This helps explain why "The trend towards colder winters, which many authors have detected from 1540 on, a trend which persisted between 1600 and 1850, was not catastrophic from the economic point of view", Ladurie, Times of Feast, Times of Famine, p. 289.

Section 3: land and population

With some knowledge of changes in the resource base over time, we are now in a position to evaluate the usefulness of Ester Boserup's theory of agricultural change. Surprisingly, her theory has met with a hostile reception from economic historians[59], although it has stimulated debate and interest among economists, geographers and anthropologists[60].

Briefly, Boserup constructs a typology of agricultural systems, ranking each according to the intensity of land use. As an index of agricultural intensity, she uses the length of the fallow period. The result is a kind of agricultural stage theory, ranging from the very long fallows characteristic of slash and burn agriculture up the scale to systems of permanent rice cultivation where fallow

59. Eg. Folke Dovring's review in the Journal of Economic History, vol. 26 (1966), pp. 380-381. An exception is Jan de Vries, The Dutch Rural Economy in the Golden Age, 1600-1700, (Yale 1974), Ch. 1.

60. Eg. D. K. Bhatia, "Some reflections on the anti-Malthus theory of Mrs. Boserup", Indian Journal of Economics, vol. 48, (1968), pp. 427-435; B. A. Datoo, "Towards a reformulation of Boserup's Theory of Agricultural Change". Economic Geography, vol. 54, No. 2., (April, 1978), pp. 135-144; D. B. Grigg, "Population pressure and agricultural change", Progress in Geography, vol. 8, (London, 1976), pp. 133-176; William A. Darity, Jnr., "The Boserup Theory of Agricultural Growth. A Model for Anthropological Economics", Journal of Development Economics, vol. 7, (1980), pp. 137-157.

has been eliminated completely. The dynamic behind the change from one system to the next is population pressure.

Each successive stage in the typology requires heavier inputs of labour than the last. It follows that a change from one system to another will (ceteris paribus) be a question of necessity not choice. People don't work harder unless they have to. The stability of each system, therefore, depends on maintaining a balance between population and resources. Hence the concept of ecological equilibrium, defined as "any combination of a method and a rate of resource use which the environment can sustain indefinitely"[61]. A change from one system to the next is the result of disequilibrium caused by population pressure.

The relevance of Boserup's theory for our comparison is obvious. Because we are comparing quite different agricultural systems, we need a general theory which can relate these systems to each other in terms of their internal dynamics. Boserup provides such a theory. Moreover, her theory is extra-cultural. It can be applied to societies like Scotland and Bengal with radically different social institutions. Finally, her theory establishes historical periods for comparision: the dates at which population begins to press on resources. We shall argue that

61. Richard G. Wilkinson, Poverty and Progress. An ecological model of economic development, (London, 1973), p. 21.

the periods 1760-1840 in Scotland and 1870-1914 in Bengal represent a valid chronology for our comparison of two traditional agricultures.

The evidence for population pressure on land during these period comes from two sources: firstly, changes in land-use, and secondly, rising prices. We shall consider each in turn.

For Scotland, the evidence of increasing population pressure on land derives from a wide variety of sources. No national acreage statistics are available for Scotland before 1866[62]. Changes in cultivated area must therefore be deduced from maps. Measures of the fluctuations in the upland limit of cultivation during this period are available for two areas, one being the Ochil Hills in the Forth Valley. The upland limit of cultivation is marked by the "moorland edge", which represents the boundary between improved farmland and unimproved heather or rough grassland. A study of the Ochil Hills shows that in 1750 the moorland edge lay at an altitude of 152 metres OD. By 1783, this had risen to 260-275 and in places had reached 305 metres OD. The average rise in the upland limit of cultivation was 106 metres[63].

62. G. Houston, "Agricultural Statistics in Scotland before 1866", Agricultural History Review, vol. IX, Pt. II, (1961), pp. 93-97.

63. J. B. Moncrieff, Climatic Limits to Cultivation in the Ochil Hills, (Edinburgh B.Sc. dissertation, 1978, Geography), p. 48 and Fig. 4.3.

The moorland edge is the result of economic as well as physical factors, however, Considerations of profit and loss judged by the yield of crops and ease of access to markets will determine whether the returns from extending the cultivated area are greater than the expense of reclamation and management. Clearly, in some areas of the Forth Valley extending the limits of cultivation was unprofitable.

> "Before the rebellion of 1745, a great proportion, perhaps one tenth of the arable part of the parish, was cultivated. Even from the valley to the very brow of the hills, upwards of 800 feet [248.84 m] above the level of the sea, almost every enclosure was ploughed in regular rotation. Whereas now, it is very uncommon to see one acre in 20 of these high grounds cultivated. The reason is obvious, and every one who looks at the grounds must see it. The fields are steep, and, of course, very expensive in the culture: every plough requires 4, in some cases would require 6 horses, and never less than two men. After all this labour and expense, the produce must be scanty, and the harvest late; in some cases so late, as to endanger the crop, if not ruin it altogether"[64].

Hence in some areas the cultivated area actually contracted. The Lammermuir Hills in the southeast of Scotland provide a case in point. Between 1800-1860

64. <u>OSA</u>, vol. IX, p. 471 (Kilsyth).

1900 hectares of arable land were abandoned by farmers and reverted to rough grazing. Again, this was not the result of climatic deterioration, but the result of economic pressures, inthis case, the higher returns to be gained from pastoral farming[65]. Hence the net effect of changes in the upland limit of cultivation on the size of the cultivated area remains indeterminate.

It might be argued that the explanation for these changes in the moorland edge was climatic. This is false. Oats was the major cereal crop grown at the edge of the outfield and hence they mark the limit of cultivation. The most important climatic parameter for oats in the Ochil Hills was summer wetness[66]. (In section 2, we noted the close correlation between summer rainfall and harvest dates). Summer wetness is measured by the end of summer (September 30) potential water surplus (PWS). This is defined as the monthly rainfall totals minus the potential evapotranspiration in that same month calculated over the growing season. The critical limit for oats in 60 mm. Yet, the meteorological data shows that between 1770 and 1800 PWS did not decrease by an amount equivalent to a 106 m. rise in the limit of cultivation[67].

65. M. L. Parry, "Secular Climatic Change and Marginal agriculture", Transactions of the Institute of British Geographers, vol. 64 (March 1975) p. 9. See also, M. L. Parry, "The Abandonment of Upland Settlement in Southern Scotland", Scottish Geographical Magazine, vol. 92 (1976), pp. 50-60.

66. Moncrieff, op. cit., p. 39.

67. ibid, p. 61.

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Instead, the explanation for the extension of cultivation in the Ochils was the introduction of new technology in the form of efficient drainage. This prevented waterlogging and allowed oats to be grown at higher altitudes. Hence, it would appear that by 1760 the limits to cultivation under the existing technology had already been reached. New techniques and higher prices were necessary before it became technically feasible and profitable to raise the moorland edge.

Further evidence of land shortage is provided by numerous instances of land reclamation. The best known example in the Forth Valley is the reclamation of the Moss of Kincardine. Between 1770 and 1816 over 1,200 acres of prime agricultural land were created at an average cost of £11 an acre[68]. Less ambitious but similar schemes were reported from the parishes of Alloa and Airth[69].

Evidence of population pressure on land in Bengal is more precise thanks to the existence of statistics of cultivated area. The collection of agricultural statistics for Bengal as a whole began only in 1890. (See Appendix C). Before that date, we must rely on agricul-

68. OSA, vol. XII, p. 563. (Kincardine); Anon, "Account of the Origin, Progress and Present State of the Operations adopted for the purpose of removing, by means of water, the Moss of Blairdrummond or Kincardine, in the County of Perth.." Farmers Magazine, vol. 18, No. LXXI (1817), pp. 258, 271.

69. OSA, vol. IX, p. 133 (Airth). Select Committee on Agricultural Distress, Parliamentary Papers, 8(2), 1836, pp. 244, 246. Evidence W. Menzies (Alloa).

tural surveys of particular districts and general estimates. Exceptionally detailed surveys of Birbhum, Jessore, Rangpur and Shahabad districts were made in the early 1870's[70]. They show that by this date there was little room for extending the cultivated area[71].

The relevant statistics from Barwan *thana* in Birbhum district are given in the table 1.11 below. The statistics from the Settlement Report in the 1920's have been added for comparison.

70. Four reports were commisioned. I would like to thank Mr. John Sims of theIndia office Library and Records who located them for me. Report on the Agricultural Statistics of Beerbhoom, Burrwa and Mouresher, *Bengal Statistics Proceedings*, vol. 181, (1873), pp. 461-505; Ramshunker Sen, *Report on the Agricultural Statistics of Jhenidah, Magurah, Bagirhat, and Sunderbuns Sub-Divisions, District of Jessore*, 1872-73, (Calcutta, 1874); Gopal Chandra Dass, *Report on the Agricultural Statistics of Rungpore for the year 1872-73*, (Calcutta, 1874) in *Bengal Statistics Proceedings*, vol. 181, (1873); Moulvie Dilwar Hussein Ahmed, "*Report on the Agricultural Statistics of Shahabad, pergunnahs Baragaon, Arrah, and Behea*, (Calcutta, 1874).

71. On their accuracy see the criticisms on the Rangpur report by E. G. Glazier. *Bengal Revenue Proceedings*, vol. 905, November 1876; pp. 297-8. And on the Jessore report in *Bengal Financial (Statistics) Proceedings*, vol. 182, September 1875. Colln 8-33/34.

Table 1.11

BARWAN THANA, BIRBHUM, 1872-1920
(acres)

Classification	1872	1872(%)	1920	1920(%)
Total area	66951	100.00	67633.50	100.00
Cultivated area'	53847	80.42	64609.36	95.52
Fallow land	595	0.33	4842.79	7.16
Grazing land	3163	4.72	73.15	0.10
Rice land	49299	73.63	47147.86	69.71

Sources : Report on the Agricultural Statistics of Beerbhoom, Burrwa, and Mouresher. Bengal Statistics Proceedings, vol. 181, (1873), pp. 461-505.

The statistics show firstly, that by 1870 most land in Barwan thana was already cultivated. The cultivated area was over 80% of the total land area. The area was described in 1872 as "a tract where land is so valuable, and where cultivation has been pushed to the very limits of the culturable area"[72]. Further expansion was largely at the expense of grazing land. In 1872, pasture accounted for 4% of the total land area but by 1920 this proportion had shrunk to less than 1% and pasture land had almost disappeared altogether. Secondly, the statistics shed some light on the land/man ratio. In 1872, Barwan thana had a total population of 64173 persons, equivalent to a population density of 613 persons per square mile. This was

72. Bengal Statistics Proceedings, vol. 182, (1874). Appendix D. p. 7.

exceptional. In 1872, only three out of 29 districts in Bengal had population densities of over 600 per square mile. The average population density in both South and West and North and East Bengal was 485 persons per square mile[73]. But by 1911, eleven districts had population densities of over 600 per square mile. The average population density in S & W Bengal was 610 and in N & E Bengal 690. Dacca was the most densely populated district with a population density of 1066 persons per square mile[74]. When we recall that in Barwan _thana_ a population density of 613 persons per square mile was associated with 80% of the total land area under cultivation, it seems fair to describe the period after 1870 in Bengal as one characterised by mounting population pressure on resources.

General estimates of the cultivated area in 1870 show similar evidence of population pressure. Statistics of cultivated and uncultivated area are available for each district in the Bengal Presidency from the district returns made by the Collectors in 1872-73[75]. The totals for each administrative division are shown in table 1.12 below.

73. H. Beverly, _Report on the Census of Bengal_, (Calcutta 1872); General Statement A.

74. Census of India, 1911, vol.

75. I have been unable to trace either the instructions issued to Collectors or the returns XLIB. The returns are printed in _Bengal Statistical Proceedings_, vol. 892, (1876), Colln. 1-18/19.

Table 1.12

TOTAL CULTIVATED AREA, BENGAL, 1872-1914

(acres)

DIVISION	(I)	(2)	%	(3)	(4)	%
Burdwan	9573.23	12719.00	75.26	7730.15	13948.00	55.42
Presidency	8403.82	16659.00	50.44	7744.28	17467.00	44.33
Rajshahi	9624.23	15116.00	63.66	11744.06	15152.00	77.50
Dacca	11107.65	18276.00	60.77	11097.29	16244.00	68.31
Chittagong	1949.65	4055.00	48.08	5563.54	6635.00	83.85
Patna	19945.15	23732.00	84.04	13273.84	17368.00	76.42
Bhaughlepur	9945.61	18685.00	53.22	13574.03	18609.00	72.94
Total	70549.38	109242.00	64.58	70727.20	99209.00	71.29

Sources: Bengal Statistics Proceedings, vol. 892, (1876) Colln. 1-18/19.
Agricultural Statistics of Bengal for the years 1909/10-1913/4.
Agricultural Statistics of Bihar and Orissa for the years 1911/12-1913/4.
Agricultural Statistics of Eastern Bengal and Assam for the years 1909/10-1910/11.

Notes:
(1) Total cultivated area 1870.
(2) Total land area 1870.
(3) Total cultivated area 1914.
(4) Total land area 1914.

The Table shows the percentage which the total cultivated area bore to the total land area in 1872 and 1914. On average, about 65% of the land area in Bengal was under cultivation at the beginning of our period. This was lower than the corresponding figure of 80% for Barwan thana. But the total land area includes land unfit for cultivation. When the total cultivated area is expressed as a percentage of the culturable area, the picture changes. Table 1.12 shows that in 1872 over 80% of the area fit for cultivation was already under crops. In Barwan, the figure was 93%. These figures may be compared with the corresponding statistics in 1914. Whereas in 1872 65% of the total land area was under cultivation, in 1914 the proportion had risen to 71%. The figures in Table 1.13 show a similar increase. Whereas in 1872 80% of the culturable area was under cultivation, by 1914 this had risen to nearly 86% The quantitative data, therefore, supports our hypothesis that by 1870 Bengal agriculture was close to the limit of cultivation.

Table 1. 13

CULTIVATED AND CULTURABLE AREAS, BENGAL, 1872-1914

(square miles)

DIVISIONS	(1)	(2)	%	(3)	(4)	%
Burdwan	9573.23	11089.95	86.36	7730.15	9416.64	82.09
Presidency	8403.82	11720.94	71.69	7744.28	10665.85	72.60
Rajshahi	9624.23	12157.52	79.16	11744.06	12867.00	91.27
Dacca	11107.65	14135.13	78.58	11097.29	12436.25	89.23
Chittagong	1949.65	3787.23	51.47	5563.54	5815.23	95.67
Patna	19945.15	21787.21	91.54	13273.84	14675.82	90.44
Bhagalpur	9945.61	12205.85	81.48	13574.03	16647.01	81.54
Total	70549.38	86883.86	81.19	70727.20	82523.83	85.70

Sources: See Table 1.12 above.

Notes:
(1) cultivated area, 1872
(2) culturable area, 1872, includes natural grass lands, fallow, and uncultivated, omitting woods and forests except in Chittagong division where the last category has been included.
(3) cultivated area, 1914
(4) culturable area, 1914, includes total cultivated area plus culturable waste other than fallow.

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A second source of evidence for population pressure on land is provided by the shortage of pasture land for cattle. Earlier, we noted that the expansion of the cultivated area in Barwan <u>thana</u> after 1872 took place at the expense of grazing land. Complaints about the shortage of pasture land in Bengal recur with increasing frequency after 1870. The agricultural survey of Jessore reported:

> "Wherever I have gone I was met by the usual complaint that the increased avidity with which land was being taken up for cultivation has deprived cattle of its pastures, and that the only grazing commons, if these could be styled as such, were the road-sides, the <u>bhagars</u>, where dead cattle are cast away, the burial spots, and river sides"[76].

In the 1880's, the shortage in some districts was already acute:

> "It is notorious that grazing grounds used to exist in every village, and now there are none. What has become of them? They have been cut off and settled for cultivation with individual ryots, and are no longer available for common use. The

76. Ramshunker Sen, <u>op. cit.</u>, p. 60. For other comments on the shortage of spare land, see Ralph Smyth, <u>Statistical and Geographical Report of the 24-pergunnahs District</u>, (Calcutta, 1857) p. 3. W. W. Hunter, <u>A Statistical Account of Bengal</u>, (London, 1876), vol. VII, p. 206, (Rangpur), II, p. 71 (Naddea); I, 154 (24 Perganas), IV, 251 (Bankura) and J. Goeghagen, <u>Report on the Statistics of the Beerbhoom district</u>, (Calcutta, 1874), p. 20.

cattle cannot run about anywhere. They are in some places not allowed on the fields even in the cold weather. When let out, they must be tethered on some barren patch with a blade or two of grass here and there... Similarly, the "ails" or boundary ridges of fields used to be wide and suitable for the ryots' walking along to his fields, and very useful for grazing cattle on. They are now little mud threads. High rents and measurement have done this. No ryot can afford to leave so much land uncultivated. He cuts in on one side, and his neighbour has to resist or cut in on the other"[77].

By 1910, the shortage had prompted the Government of Bengal to launch an official enquiry. The cattle census of 1912 recorded the acreage of grazing land in each district of the Bengal Presidency[78]. The Table below shows the amount of grazing land as a percentage of the uncultivated area between 1872-1914. Unfortunately, the 1872 figures recorded only "natural grass land" and there is no clear evidence of a decrease in pasture land. The qualitative evidence gives a more accurate picture.

77. R. Carstairs, Condition of the Rvots of part of Chanditala Thana in Hooghly District, and a description of the various crops and methods of cultivation in use among them. Being part II of a Report on Rates, (Calcutta, 1883), pp. 47-47.

78. J. R. Blackwood, A Survev and Census of the Cattle of Bengal, (Calcutta, 1915).

Table 1.14

CHANGES IN PASTURE AREA, BENGAL, 1872-1914
(square miles)

DIVISION	(1)	(2)	%1914	%1872
Burdwan	1077.04	6217.85	17.32	11.44
Presidency	280.12	9722.72	2.88	15.63
Rajshahi	304.82	3407.94	8.94	14.73
Dacca	559.16	5146.71	10.96	15.51
Chittagong	99.19	1071.46	9.25	2.55

Sources : Bengal Statistical Proceedings, vol. 892 (1876) Colln. 1-18/19
J. R. Blackwood, A Survey and Census of the Cattle of Bengal, (Calcutta, 1915). Appendix II , pp. iii-vi.

Notes: (1) pasture land, 1914.
(2) uncultivated area, 1914.

A third source of evidence for population pressure on land is the area of culturable land left fallow each year. According to Boserup's theory, reduction in fallow is a clear indication of land shortage. The evidence for such a change in Scotland is clear cut. Under the traditional farming system of infield-outfield up to one third of all farmland was left fallow each year. This high proportion of fallow was necessary to preserve soil fertility.

"When fallow is shortened or even eliminated in a given territory, some other method of preserving or regaining fertility must, of course, be introduced. There is, therefore, a close association between the systems of fallow and the techniques for fertilisation"[79].

Fallow in Scotland was abolished in two ways. On light soils fallow was replaced by alternate husbandry, i.e., alternating roots and clover with cereal crops. On clay soils, like those in the Forth Valley which were too waterlogged for roots, fallow was replaced by convertible husbandry i.e., alternating cereals with artificial grass. The agricultural revolution in western Europe was, therefore, associated with a reduction in land left fallow and consequently a net gain in the net cropped area.

What fallow remained in Scottish agriculture was integrated into the crop rotation to permit the intensive ploughing necessary for wheat. Summer fallow, as this practice was called, was a method of removing weeds through repeated ploughings and weed gathering[80]. Its value on the Carse and boulder clays was immediately evident. "The great improvements in Scottish husbandry take their rise from summer fallow, which is certainly the first and best

79. Ester Boserup, op. cit., p. 25.

80. Francois Sigaut, "Jachere En Ecosse", Etudes Rurales No. 57, (Jan-Mar 1975), p. 93.

of all improvements on stiff tenacious clays; by that means only, the soil can be completely pulverised, levelled properly, ridged and fully prepared for the succeding crops, and without which no permanent improvement can take place..."[81]. This was far removed from the fallow of the infield-outfield system.

Evidence for the abolition of fallow in Bengal is ambiguous. The very existence of fallow in Bengal agriculture was questioned by some early observers. "Nowhere, apparently", one wrote, "has it occurred to them that anything is to be gained by giving their fields the complete rest which is afforded by a clean fallow"[82]. Despite such superficial judgements, it is clear that fallow did constitute an integral part of the rotation in Bengal: "the value of rest or fallow (patit) they perfectly understand and generally put in practice, especially where their lands are of a light and exhaustive nature; but the period of fallow seldom extends over one year, and only at intervals of two or three years..."[83]. As in Scotland, fallow was necessary to restore soil fertility, since continuous

81. Sir John Sinclair, Materials collected for drawing up an account of the husbandry of Scotland, (London, 1810), p. 53. Answers by James Boyd of Powis, near Stirling.

82. "System of Rotation of Crops observed among native agriculturalists", Journal of the Agricultural and Horticultural Society of India, vol. XIII (1863-64), Correspondence and Selections, pp. 73-74.

83. ibid, p. 70.

cropping with rice or jute exhausted the soil[84].

Yet, despite the evidence of population pressure on land provided by the rise in total cultivated area, there was no reduction in fallow in Bengal. Instead the area left fallow actually increased. The scale of this increase is shown in Table 1.15 below:

84. Ramshunker Sen, op. cit., pp. 4-5. Queried on this by the Collector, Sen replied, "The cultivators were nearly unanimous in their opinion that while the yield of the best land in the first year was 16 annas, that in the second year was 10 annas and sometimes 8 annas, while in the third year the same land yielded 6 to 4 annas of the first..." Bengal Financial (Statistics) Proceedings, vol. 182, September 1875. Colln 8-33/34 See also Hunter, Statistical Account of Bengal (London, 1876), vol. IV, p. 269 (Bankura).

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Table 1.15

INCREASE IN CURRENT FALLOWS, BENGAL 1890-1914

(000 acres)

YEARS	(1)	(2)	(3)	(4)	(5)
1890-91	987	30182	4522	34704	10.46
1891-92	1235	29934	4400	34334	16.26
1892-93	3949	27220	4777	31997	12.27
1893-94	3402	27767	5124	32891	20.15
1894-95	2244	28925	4582	33507	9.73
1895-96	3297	27872	4574	32446	10.72
1896-97	4154	27015	4632	31647	11.26
1897-98	2060	29109	5618	34727	10.97
1898-99	2042	29580	5288	28828	8.07
1899-1900	2354	29155	5486	34641	13.72
1900-01	2931	28210	5282	33492	9.44
1901-02	2895	27927	5437	33364	8.71
1902-03	2871	27941	5377	33318	18.39
1903-04	3057	27046	5865	32911	7.04
1904-05	2447	28451	6452	34903	16.02
1905-06	3095	28300	6584	34884	17.94
1906-07	3528	27770	6948	34718	8.83
1907-08	4021	27120	6707	33827	12.43
1908-09	4570	26599	5889	32488	8.04
1909-10	3649	27725	6154	33879	11.12
1910-11	3603	27383	6114	33497	10.06
1911-12	3961	27789	5797	33592	14.96
OLS % p. a.	+3.568	-0.279	+1.825	+0.110	+20.134

Source: K . L. Datta, An Enquiry into the Rise of Prices in India, (Calcutta, 1914), vol. 3, pp. 300-1, 304-5, 433-5.

Notes: (1) Current fallows, (2) Net cropped area, (3) Double-cropped area, (4) Total cropped area, (5) Rainfall March-May (inches).

The Table shows that between 1890-1912 the fallow area in Bengal grew at an annual rate of 3.5%. This might appear to invalidate the application of Boserup's theory of agricultural change to Bengal, but this theory still applies, for three reasons. First, the increase in the fallow area was localised: the annual growth rate in current fallows in N &E Bengal was only +0.645% compared to +2.139% in S & W Bengal. Most of the increase, therefore, occurred in the area of the moribund delta. Some districts experienced a decline in fallow and an increase in net cropped area. This is illustrated by the comparison of the trend in net cropped area in Dacca and Burdwan (Figure 1.15). In Dacca, the increase in net cropped area was clearly the result of population pressure. Reports in the early 1870's stressed that "fields are seldom allowed to remain fallow" in the southern half of the district[85]. By 1914, the Settlement Report recorded only 14 square miles of fallow in the entire district. "These figures show the extraordinary pressure on the soil in Dacca... This implies that a period of 156 years is required until every acre has been relieved of its burden of bearing its one or two crops"[86]. Secondly, the increase in fallow was accompanied by an increase in double-cropped area. Table 1.15 shows that between 1890-1912, the twice cropped area in Bengal grew by an annual rate of nearly 2%. This

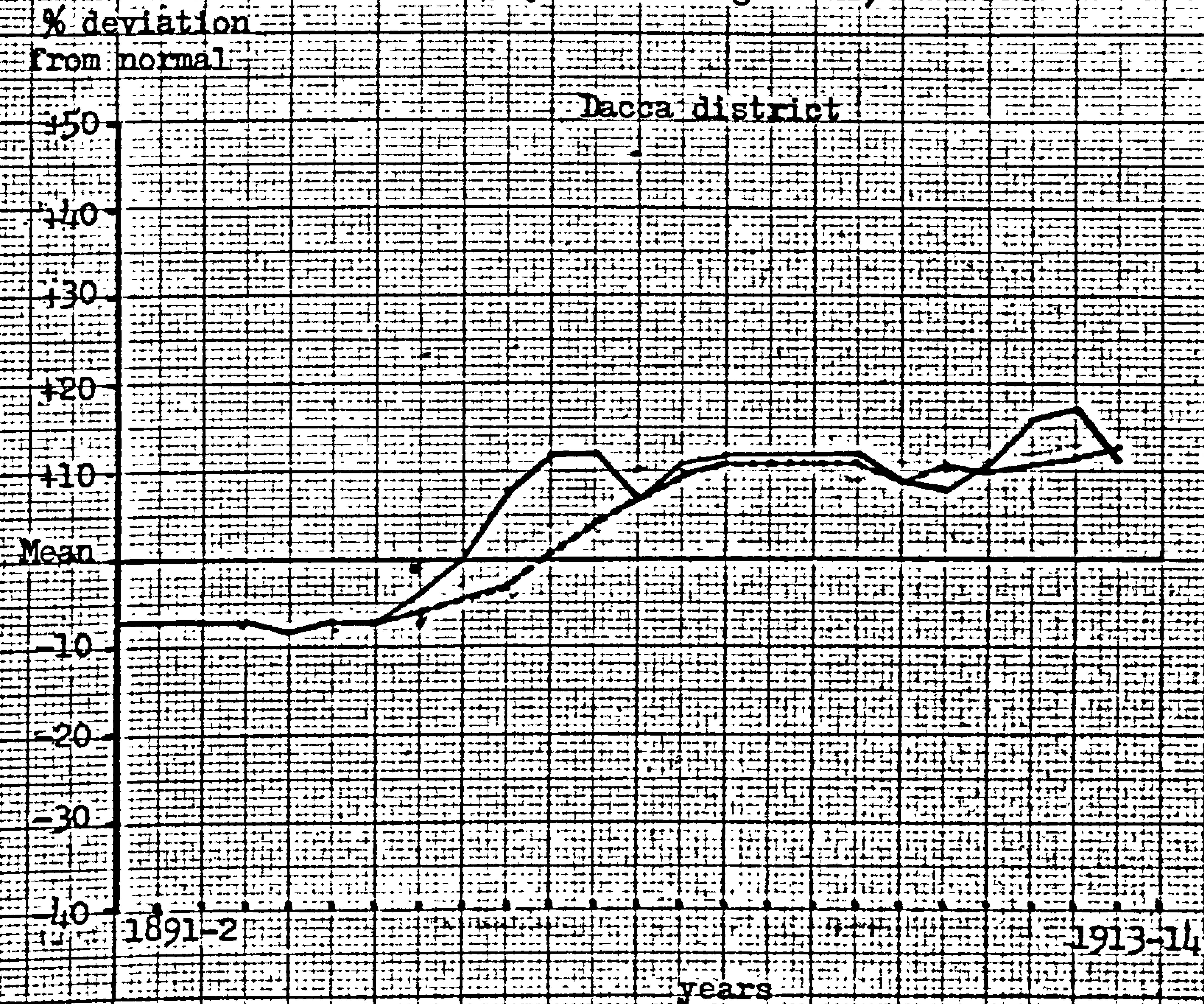
85. Hunter, op. cit., vol. IV, p. 102.

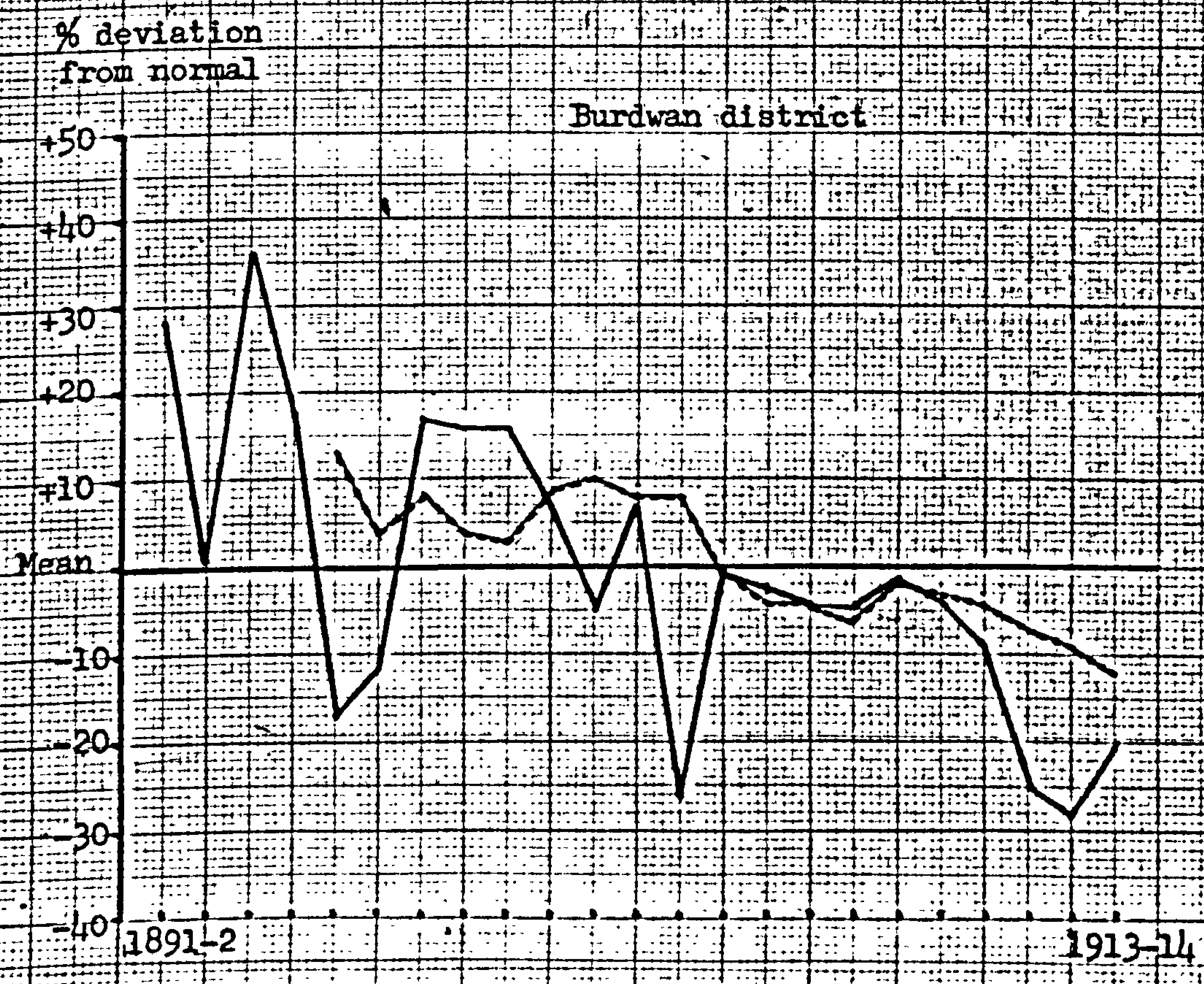
86. F. D. Asioli, Final Report on the survey and settlement operations in the District of Dacca, 1916-17, (Calcutta, 1917), p. 40.

Figure 1.15

Change in net cropped area, Bengal 1890-1914

(5-year running means)



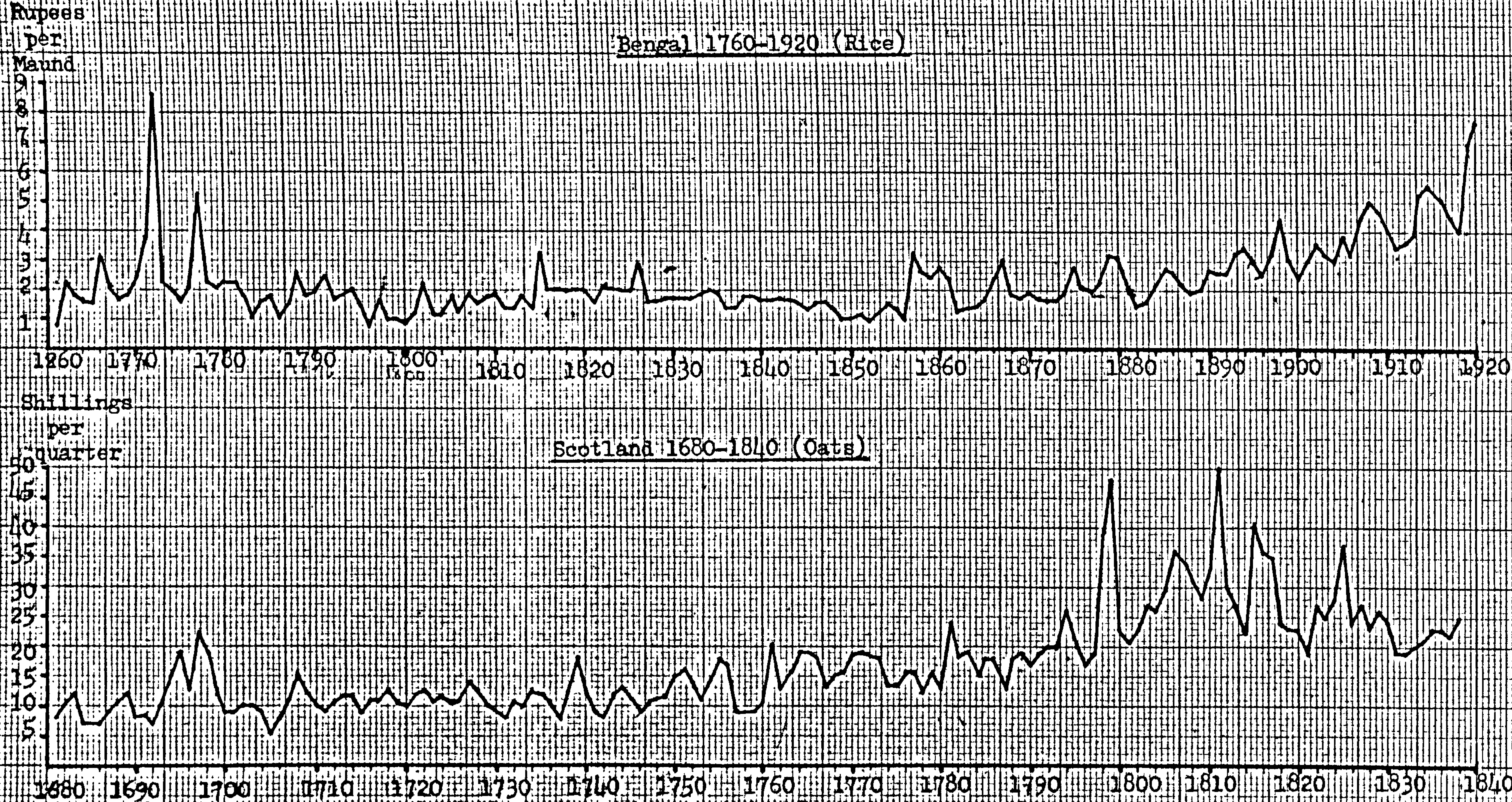


is clear evidence of mounting population pressure. The districts with the biggest double cropped areas, like Dacca, were also the most densely populated. It was largely as a result of the spread of double-cropping that the total cultivated area in Bengal stayed constant and did not fall.

Finally, there is the evidence of rising prices. Population pressure on resources results in disequilibrium between the supply and demand for food. The sequel is price inflation. Comparative trends in the price of the staple food crops in Scotland and Bengal are shown in Figure 1.16. These show striking similarities. Both show that before 1760 in Scotland and 1870 in Bengal there was a century of steady prices except for violent fluctuations caused by famines (1770 in Bengal, 1690's in Scotland). After these dates, there is a price rise. The secular trend in prices in the periods chosen for comparison was upwards in both cases. The increase was approximately the same in each case. Rice prices in Bengal rose from a base of 100 in 1860 to 171 in 1905, while in the Forth Valley oats prices rose from a base of 100 in 1760 to 183 in 1840. (Tables 6.18, 6.19 above). In terms of price movements, therefore, both economies were in phase in the periods chosen for comparison.

Figure 1.16

Secular trends of cereal prices in the Bengal Presidency and the Forth Valley



In sum, therefore, the evidence of population pressure on land in Scotland before the agricultural revolution confirms Boserup's hypothesis that innovations to raise land productivity result from the necessity of feeding more people with the same resources. This generalisation holds true not just for Scotland, but for continental Europe as well:

> "All over the Continent, demographic increases preceded the economic developments inaccurately known as the 'Agricultural Revolution' and the 'Industrial Revolution'. It was, indeed, demographic pressure that forced the peasants of Europe to cultivate the land more intensively and so bring more land under cultivation. If food supply had increased before population did, supply would have exceeded demand and prices would have been on the decrease, whereas we can see a continuous increase in prices throughout Europe from 1750 onwards ... Agriculture made progress on all sides as a result of demographic pressure. It was not technological innovation which burst the constricting framework of peasant production, but a widening range of needs which gave rise to technological innovation"[87].

Innovation in the Forth Valley began about 1760, the year contemporaries remembered as one "when the great

87. Jacques Dupaquier, "Population", in Peter Burke (ed.), The New Cambridge Modern History, vol. XIII. Companion volume, (Cambridge, 1979), pp. 100-101.

changes commenced"[88]. By comparison with what followed, very little change took place in earlier decades: in Kippin, improvements were unknown before 1750[89]. Summer fallow, the abolition of runrig, the introduction of artificial grasses, all the major technological changes arrived in the 1760's[90]. Like Scotland between 1760-1840, the period 1870-1914 in Bengal was also characterised by population pressure on land. Like the Forth Valley, population pressure was evidenced by extensions to the cultivated area, reductions in fallow and increased double-cropping, and rapid price-inflation. Both agricultures are therefore comparable between these dates.

88. John Ramsay of Ochtertyre, Scotland and Scotsmen in the Eighteenth Century. Ed. by A. Allardyce (Edinburgh, 1888), vol. 2. p. 243.

89. OSA, vol. IX, p. 539, (Kippen)

90. Robert Belsches, General view of the Agriculture of Stirling, with observations on the means of its improvement. (Edinburgh, 1796), p. 29; OSA, vol. IX, p. 231, (Campsie).

Conclusion

Environmental explanations of agricultural stagnation in Bengal seem unsatisfactory for several reasons. Firstly, Bengal enjoyed significant natural advantages. In terms of climate and soil fertility Bengal was far superior to the Forth Valley. A measure of these advantages is seen in the sheer size and density of Bengal's population. Secondly, despite her dependence on the monsoon, there is no evidence to suggest that Bengal was more vulnerable to climatic fluctuations than Scotland. Cyclical changes in monsoon rainfall were shown to have had less impact on agricultural production and prices in Bengal than colder winters and wetter summers in Scotland. The effects of long term environmental changes in Bengal also seem to have been exaggerated. The decline in soil fertility caused by changes in the river systems was far from universal and confined to particular districts. So far as the impact on agricultural production can be quantified, the loss in output was not so severe as previously thought. Nor does malaria appear to have reduced the labour supply. Again, attempts toreverse the decline in net cropped area and the spread of malaria were frustrated not so much by physical as by social factors. Our conclusions, therefore, vindicate Gourou's judgement, quoted at the head of this chapter, on the nature of the

the relationship between man and environment. This relationship assumed a new importance with the stimulus given to technological change by growing population pressure on land, which is the common feature of both periods. The question remains, why did this same economic stimulus produce such verv different results?

Chapter 2

Labour Productivity

After land, labour is the most important input in traditional agriculture. Capital is not only much less important in quantity, but also it is largely a direct embodiment of labour in the form of land improvements, irrigation systems and simple tools. Hence by comparing labour productivity we shall, in effect, be comparing the productivity of both agricultures. Of the three different forms of albour productivity, we shall measure output per unit of labour input, ignoring, for the moment, worker productivity (output per worker), and labour force productivity (output of the total labour force)[1]. The method adopted was to measure the mandays per acre required to produce the staple food and major commercial crops.

This approach is hampered by serious gaps in the historical evidence. The data on labour inputs in 19th century Bengal agriculture is scattered, patchy and calls for some guesswork. The two principal sources were reports written in the 1890's on agriculture of Burdwan and Dacca

1. John W. Mellor, "Major Determinants of the Productivity of Agricultural Labour", in K. Hunt, ed. Proceedings of the Thirteenth International Conference of Agricultural Economists. (London, 1969), p. 242.

districts, which give detailed breakdowns of cultivation practices. These were supplemented by other contemporary reports like those on Barawan and Chanditala *thanas*[2]. Finally, to calculate labour inputs for commerical crops reference was made to modern sources, notably the latest *Costs and Returns Survey for Bangladesh*[3]. Similar reports are available for 18th century Scottish agriculture. Information on cultivation in the Forth Valley can be gleaned from the General Views of Stirlingshire and Clackmannanshire commissioned by the Old Board of Agriculture and from the Old Statistical Account. Where necessary, gaps were filled by reference to similar sources from other areas. Information on labour inputs was culled from specialist publications[4].

2. *Bengal Statistics Proceedings*, vol. 181 (1873), pp. 461-505. Report on the Agricultural Statistics of Beerbhoom, Burrwa and Mouresher; Carstairs, *Condition of the Ryots*.

3. *Costs and Returns Survey for Bangladesh, 1978-79 Crops. Agro-Economic Research Section. (Dacca, 1979), 9 vols.* M. A. Jabbar and A. K. M. Faruque, "Labour Requirements for production of major crops in Bangladesh", *The Bangladesh Journal of Agricultural Economics, vol. 1, Nol 1, (June, 1978), pp. 101-113.* I am grateful to Dr. Carl E. Pray of *BARC* for this reference.

4. John C. Morton, *Labour*. Morton's Handbook of the Farm Series, No. 1X, (London, 1860); Primrose McConnell, *Notebook of Agricultural Facts and Figures for Farmers and Farm Students*, (London, 1883); W. Burness, "Taskwork in England", *Journal of Agriculture*, NS, vol. V11, (July, 1849-March 1851), pp. 137-154; Hugh Raynbird, "On Measure Work". *Journal of the Royal Agricultural Society of England, vol. V11, (1846).*

We shall divide our analysis of labour productivity into three sections. The first section will establish the labour coefficients for the major farming tasks. In the second, we then determine the labour inputs for particular crops. Finally, the third section will compare our results for Scotland with the data for Bengal.

Section 1: Labour Coefficients

We must begin by standardising our unit of measurement, the man-day. This did not vary geographically, being a function of horse-power, and makes it legitimate to use data for areas outwith the Forth Valley. But it did vary seasonally. In summer, two yokings of 5 hours each were standard while in winter, the early dusk shortened them to 4 hours. Similarly, day-labourers worked a ten hour day in summer, but only 8 in winter.[5] Our coefficients will be based on a working day of 10 hours.

A second problem of definition arises over the employment of child and female labour. In the eighteenth-century, both played an increasingly important role in the labour force. This was partly because the growth of manufacturing towns created a shrinking labour market for adult males. But equally important was the fact that the new farming techniques required more seasonal labour than before. The agricultural revolution was above all a triumph ofhuman muscle: more people toiling longer and harder than ever before. Children were not exempt. Indeed, one of the advantages of the new technology was that

5. Graham, General View Stirlingshire, p. 311; Robertson, General view Southern Perthshire, pp. 85-86; Mr. Carmichael, "Essay on the State of Agriculture in the Vale of Forth", Essays and Prize Transactions of the Highland Society of Scotland, NS, Vol. X, No. IV, (1835), p. 23.

their labour could now be exploited more effectively. Harvesting by the scythe, for example, meant that corn "can be collected from the swath to the sheaf by boys or girls from 12 to 14 years of age", whereas harvesting by the sickle required adults[6].

A conversion factor must therefore be used. The problem is simplified to some extent by a division of labour between the sexes. Ploughing, and threshing by the flail were exclusively male tasks[7]. But women were recognised as fully equal to men in terms of skill for a variety of other tasks - barn work, for example[8]. And in others, their output was higher than mens'. Women reapers, for example, were faster: "what is called a maiden ridge of 3 young women, will beat a bull ridge, of 3 men, at reaping any sort of corn, on any given day"[9]. Women also excelled at threaving, or harvest piece-work[10].

6. David Souter, General View of the Agriculture of Banffshire, (London, 1812), p. 271 note.

7. Graham, General View, p. 313.

8. Henry Stephens, Book of the Farm, (London, 1844), vol. 1, p. 227.

9. ibid, vol. 3, p. 1050.

10. George Robertson, General View of the Agriculture of Kincardineshire, (London, 1813), p. 264.

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Such evidence makes it unwise to adopt a conversion factor below 1:1. For children, we use a factor of 1:5.

In Bengal, unlike Scotland, the length of the working day was not a function of animal power. Normally, bullocks were worked only 4-6 hours daily, and only in the mornings. In Rangpur district, no ploughing was done after 1 p.m; afternoons were reserved for other tasks[11]. Throughout the delta, estimates put the length of the normal working day at 6 hours. "Unlike the people of Bihar, the cultivators do not work for more than six hours a day"[12]. In Noakhali, seven hours was said to be normal[13]. But this description of Jessore seems to hold true for the rest of Bengal:

> "The ryot begins work at early day dawn... he has already taken his early breakfast (<u>rashta</u>)at home, or it is brought to the field at 7 or 8 a.m. by some inmates of his house. He works up to 12 o'clock or 1 p.m.,... after which he returns home... he again goes forth at 2-1/2 p.m. or 3, spade in hand, to trim his ridges, or to weed returning home at dusk" [14].

11. Hunter, SAB, vol. 7, p. 226.
12. Dass, Report on Rungpore, p. 226.
13. Hunter, SAB, vol. 6, p. 296.
14. Sen, Report on Jessore, p. 86.

No conversion factor for female labour was employed on the assumption that social and cultural factors prevented the use of female field labour. (See Chapter 3, Section 1).

We begin our discussion of coefficients with those for animal-labour, in ploughing, harrowing and rolling.

3.1.1 Ploughing.

Output per man-day in ploughing depended on a variety of factors: the soil, depth and breadth of the furrow-slice, the nature of the ploughing and the season, all determined the speed of the plough. Cross-tabulations of three of these variables are available for the eighteenth-century Forth Valley in the ploughing experiments made by Erskine of Mar in Clackmannanshire. Given a furrow-slice of 8 inches, the output of a 2 horse plough in a working day of 8 hours is as follows:

Table 2.1

OUTPUT OF TWO HORSE PLOUGH

SPEED(mph)	LENGTH(yds)	AREA(acres)
1.00	14,144	0.65
1.50	21,216	0.97
2.00	28,216	1.29
3.00	42,296	1.94

Source: data reworked from Sir J. Sinclair, An Account of the Systems of Husbandry adopted in the more improved districts of Scotland, (Edinburgh, 1813), vol. I, p. 227.

Other contemporary estimates broadly confirm these results. On the loosest soils, maximum output did not rise above 1.58 or 1.69 acres in a day of 9 hours (908.84 sq. yards per hour). Minimum output was recorded during winter when soils were wet and the working day reduced to 7 hours: 0.95 acres, or 658.97 sq. yards per hour[15]. Average output thus lay somewhere between 1.36 and 1.87 acres per man-day. One estimate gives 1.41 acres as "the common calculation"[16]. Another states: "A pair of horses

15. David Low, Elements of Practical Agriculture, comprehending the cultivation of plants. (Edinburgh, 1834), p. 156.

16. Alexander Lowe, General View of the Agriculture of Berwick, (London, 1794), p. 43.

often plough a Scotch acre out of lea (grass) in one day, but three roods (0.95 acres) is a common days work"[17]. But these averages seem high when compared with coefficients for England at a later date. Both Morton (1861) and McConnel (1883) give coefficients of 1.25 acres per man-day[18]. We accept this later estimate on the grounds that Scottish improvers were probably exaggerating their claims for a new technique, the 2-horse plough.

The 'old Scotch plough' required at least four draught animals, extending in multiples of two right up to 12. Output depended on the numbers of animals used. In Caithness, "Three persons, with four horses or oxen,... would not plough much above a quarter of an acre a day"[19]. This is equivalent to 0.317 imperial acres, which agrees with otherestimates for larger animal teams. Output with 8-12 oxen was reportedly 1.27 imperial acres per day[20]. The maximum recorded output for an ox team was "a whole (Scots) acre (1.95 acres) ploughed on the baks of the Dee, by 12 oxen, in about 6-1/2 hours. But this was accounted

17. Andrew Whyte and Duncan MacFarlan, General View of the Agriculture of Dunbarton, (London, 1811), pp. 235-236.

18. Morton, op. cit., p. 99; McConnell, op. cit., p. 78.

19. John Henderson, General View of the Agriculture of Caithness, (London, 1812), p. 57.

20. ibid.

a great exertion"[21]. This gives an output of 0.65 acres for two pairs of oxen, or double the estimate from Caithness. Since this clearly represents the maximum we can be fairly confident that the earlier estimate represents the norm. We shall take output per ox-pair-day as 0.33 acres.

Three men were needed to operate the old plough[22]: the ploughman, who controlled the lift of the plough, the goadman, who kept the animals moving and another who walked backwards in front of the leading animals, holding their halters or bridles in order to guide the plough around large stones. So, (assuming output remained the same), it needed 3.00 man-days to plough 1.25 acres, whereas the 2 horse plough was operated by one man. Despite this, the old plough was still in use in the Forth Valley in the 1790's; only by the 1840's had the 2-horse plough become universal. We shall take 2.5 mandays per acre as our labour coefficient with the old Scots plough.

21. G. S. Keith, General View of the Agriculture of Aberdeenshire, (London, 1811), p. 227.

22. James Donaldson, Modern Agriculture, or the present state of husbandry in Great Britain, (London, 1795-1806), vol. 3, p. 294; Henderson, op. cit., p. 57; OSA, vol 1X, p. 169 (Baldernock), vol. X11, p. 164, (Callendar).

As with the plough, two kinds of harrows were in operation. The "common" harrow, 3 feet broad, with 16-25 tynes, and drawn by one horse, was the kind generally found in the Forth Valley in the 1790's[23]. Its small breadth meant that two were drawn together under one ploughman, and one estimate puts output by this method at 6 acres per man-day[24]. This seems accurate compared with later estimates. Morton gives 6.5 acres per man-day for a harrow of 3.5 - 4 feet breadth, McConnel the same[25]. We adopt a coefficient of 6 acres. This gives a labour coefficient of 0.16 mandays per acre.

Finally, rollers were used to smooth the ground before sowing. Output varied according to the length, weight and the number of horses used. Those in the Forth Valley in 1793 weighed 15 cwt, were 6 feet long, and were drawn by 2 and sometimes 4 horses[26]. Now, 5 feet rollers drawn by only one

23. Belsches, General View Stirling, p. 40.
24. Low, Practical Agriculture, p. 158.
25. Morton, op. cit., p. 101; McConnell, op. cit., p. 78.
26. Belsches, op. cit., p. 42.

horse were expected to cover 5 acres per man-day[27]. Estimates for 6 feet rollers drawn by 2 horses differ markedly. Two Scottish claims first. One estimates that with a speed of 2.5 mph output will be 14 acres per man-day; another, less precise, that "A pair of horses with a roller of proper construction will roll 16 acres-a day"[28]. But in England much later, two horses were only expected to roll 8 acres per man-day[29]. The discrepancy is too wide to be explained other than in terms of farming practice. Scottish farmers rolled their land once over, English farmers twice. We shall adopt the lower coefficient of 12 acres per man-day, or 0.08 man-days per acre.

27. Low, op. cit., p. 159.

28. Select Committee on Agricultural Distress, Parliamentary Papers, vol. 8(2), 1836, p. 236. Evidence of G. Robertson; Stephens, Book of the Farm, vol. 2, p. 522.

29. Morton, op. cit., p. 102.

The Bengali plough and harrow are shown in the selection of farm implements shown in Figure 2.1. Ploughing is illustrated in Figure 2.2. "Only one person attends a plough, holding the handle in one hand, and occasionally pulling the tails of the oxen with the other, to guide them, or striking them with a stick to quicken their pace"[30]. Unlike the Forth Valley, we have no experimental data on the time required to plough an acre with such a plough. One modern estimates gives 1 bigha (0.33 acres) in 5 hours, or 2.52 mandays per acre[31]. But in Jessore, it was noted that "A strong Hindu agriculturalist may plough one beegah (0.33 acres) in a day..."[32]. We shall, therefore, use the more conservative estimate of 3.00 mandays per acre.

Harrowing was done with a mai or ladder. "The Bengali harrow is, however, as unlike our harrow as any one instrument can be. It is a simple ladder of bamboo, on which one man takes his stand, while his fellow draws the bullocks to which the ladder is attached, by two cords, over the sown fields. At a distance, the ladder is imperceptible, and the ryot seems to be mowing over the surface without using his legs, as if by some magic power. The effect of this process, when carefully carried out,

30. W. Carey "Remarks on the State of Agriculture in the District of Dinajpur", Asiatick Researches, vol. 10, (1811), p. 4.

31. Ranjit Battacharya, "Social and Cultural Contraints in Agriculture in 3 Villages, (Hindu, Moslem and Tribal) of West Bengal", Journal of Indian Anthropological Society, vol. 3, (1968), p. 88.

32. Seton-Karr, "Agriculture in Lower Bengal", p. 426.

Figure 2.1

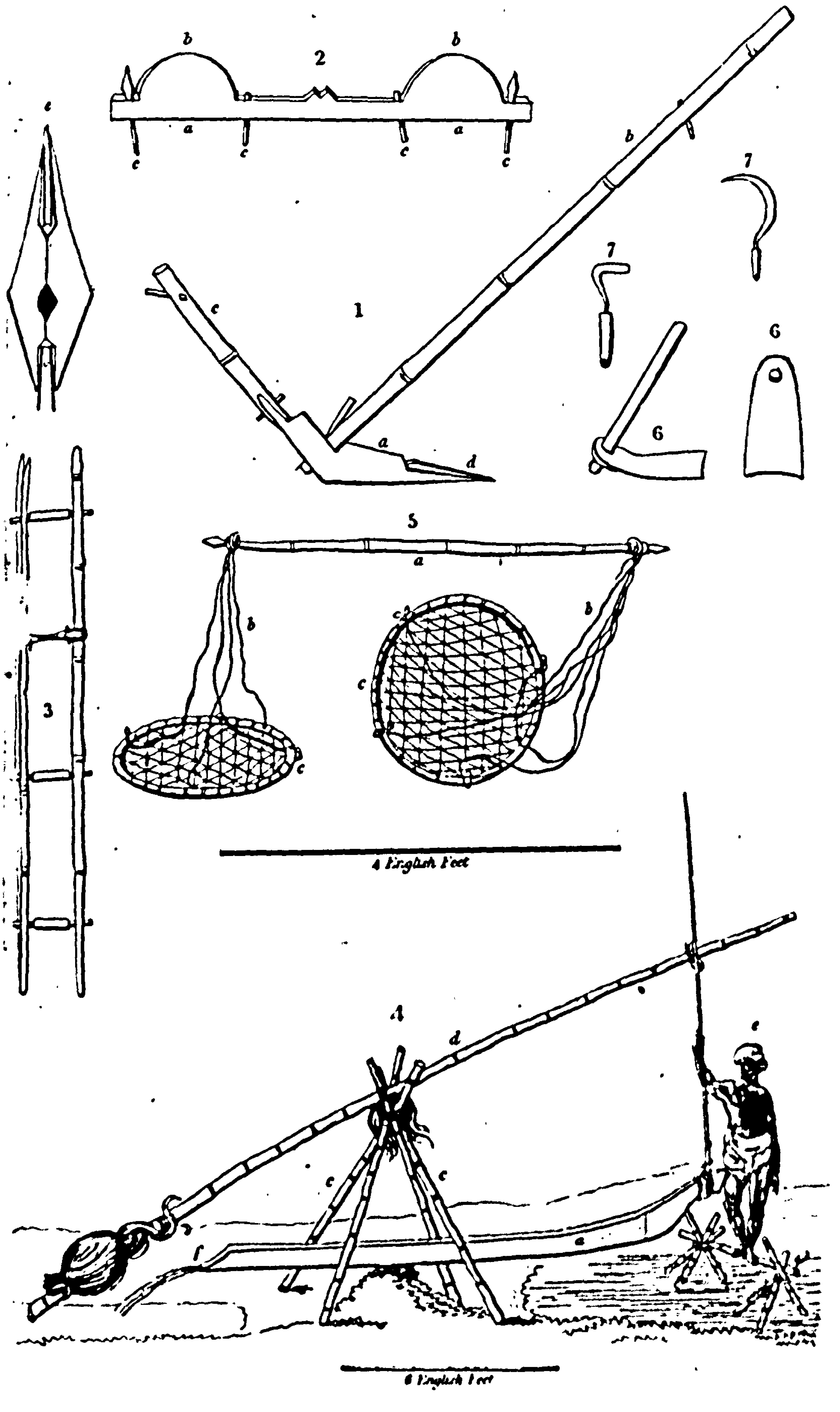


Figure 2.1

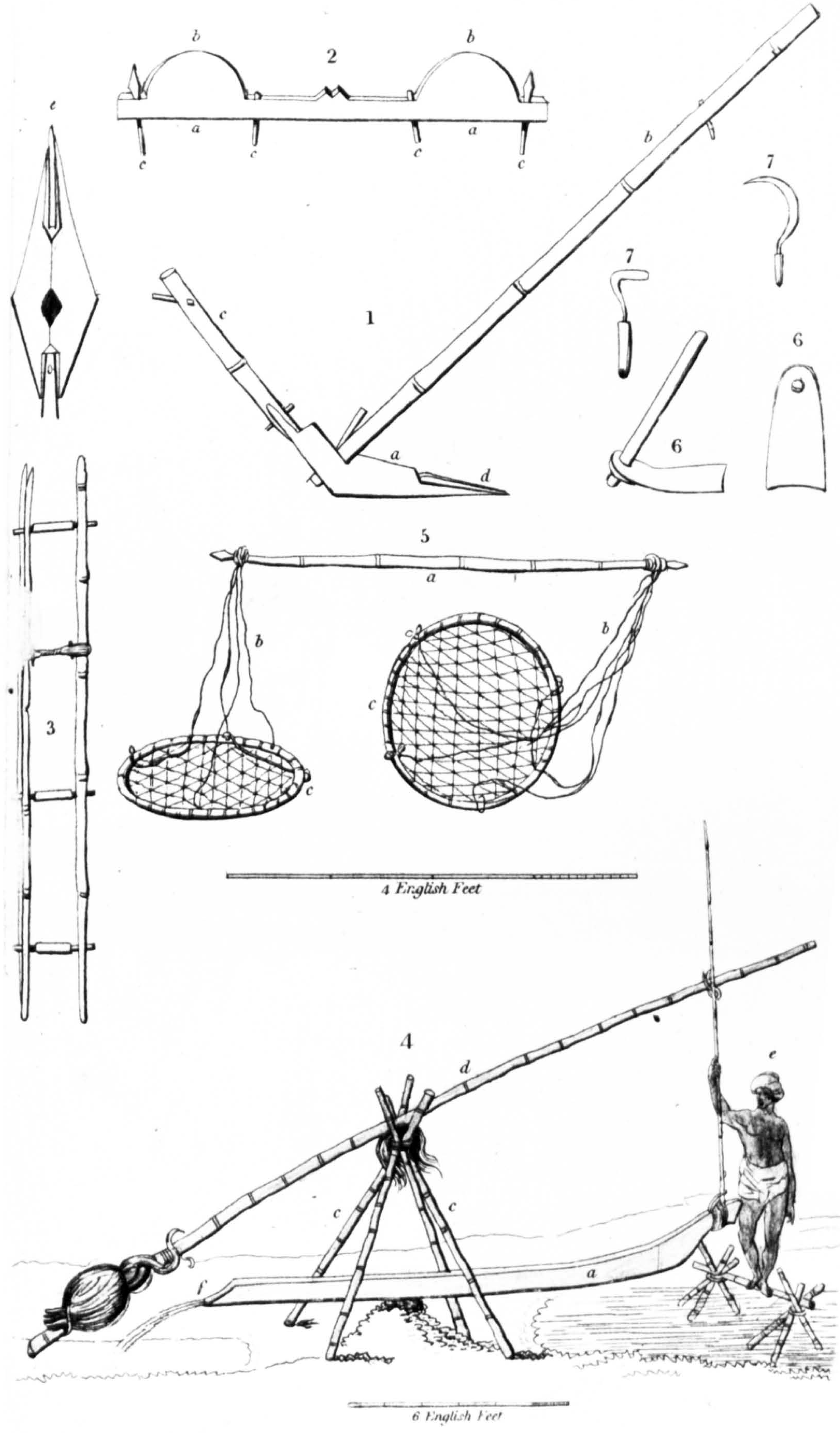


Figure 2.2

PLOUGHING.

is to make the rice ground almost as level as a bowling green"[33]. An example of the Bengali harrow is illustrated in Figure 2.3. Eight or ten bighas (3 acres) was reported as a good days' work[34]. This gives a labour coefficient for harrowing of 0.33 mandays per acre. We shall use the same coefficient for rolling.

2.1.2. Sowing.

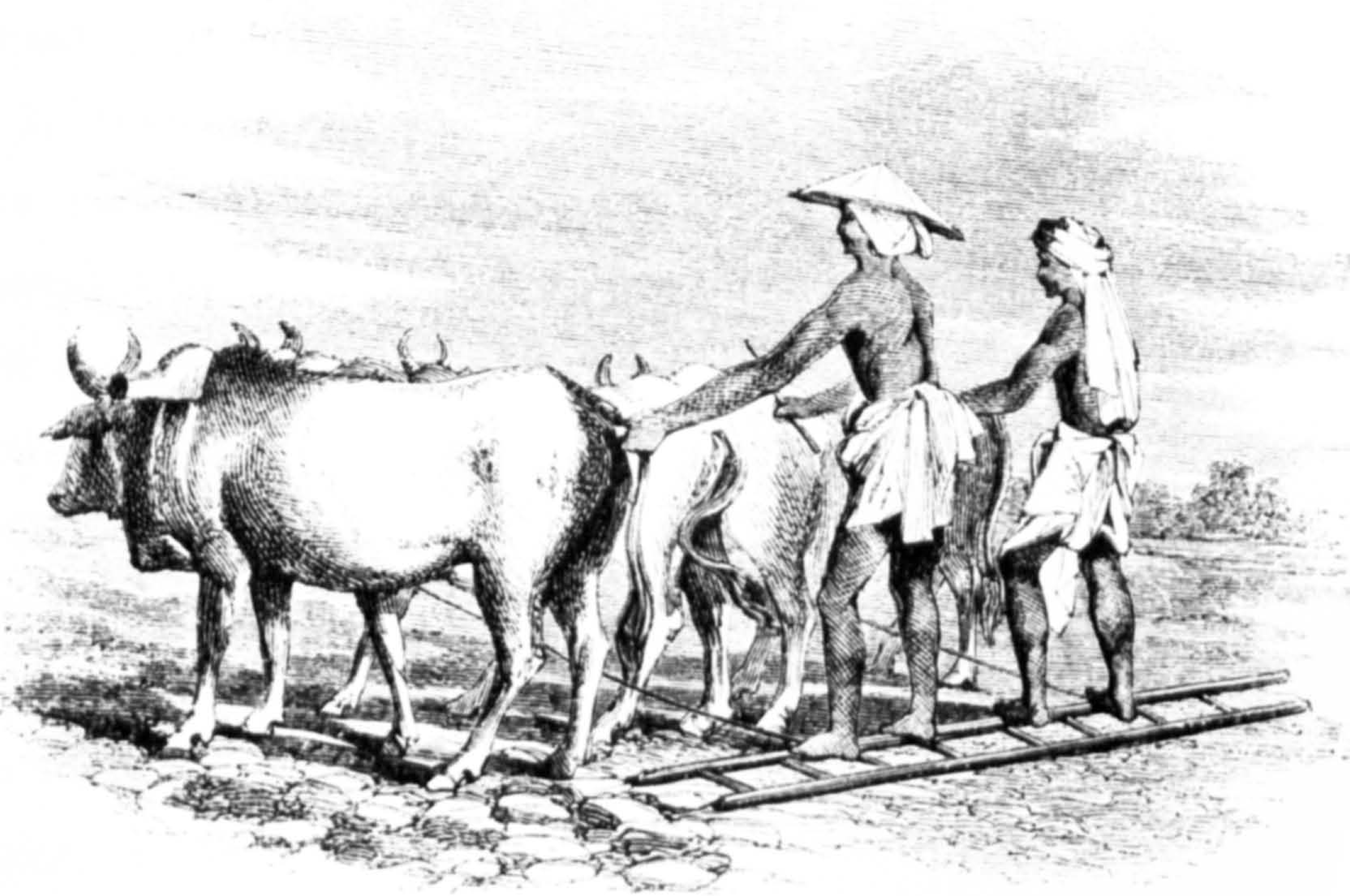
After ploughing, harrowing and rolling, the land was now thoroughly prepared for seed. Technological change was limited to the introduction of drill-sowing for turnips and potatoes (1760's), and beans (1812)[35]. All through our period, cereal crops continued to be sown by hand, even in wholly arable areas like the Carse, where soil conditions were the limiting factor[36].

33. ibid.

34. ibid.

35. Andrew Wight, The Present State of Husbandry in Scotland, (Edinburgh, 1778-84), vol. 1, pp. 143-144, (Callendar); Graham, General View Stirlingshire, p. 113.

36. Carmichael, "Vale of Forth", pp. 19-20.



HARROWING.

Broadcast sowing required only a linen cloth or sheet knotted on the left shoulder to form a bag which held about half a bushel[37]. But simple as it sounds, sowing did require skill. Each "cast" of the hand had to be evenly measured. Output depended on two factors. First, was the breadth of the ridge. Fifteen feet ridges were ideal, since this could be covered with 2 casts, once up and once down[38]. But narrower ridges of 10 feet also required 2 casts, "which is a considerable loss of time"[39]. Ridges in the Forth Valley were generally 18 feet broad[40]. The practice was to sow this with 2 casts, but 3 was considered advisable, since "most sowers are not to be trusted with sowing an 18 foot ridge equally with two casts, or going along one side, and returning on the other. The middle of the ridge is often too thin sown by those, who have the vanity of sowing 18 feet with two casts". Three casts were always necessary in high winds[41].

37. William Leslie, General View of the Agriculture of Nairn and Moray, (London, 1813), p. 127.

38. George Robertson, General View of the Agriculture of Midlothian, (London, 1793), p. 84.

39. Sir John Sinclair, An Account of the Systems of Husbandry adopted in the more improved districts of Scotland, vol. 1, p. 159.

40. Robertson, General View Perthshire, pp. 153ff.

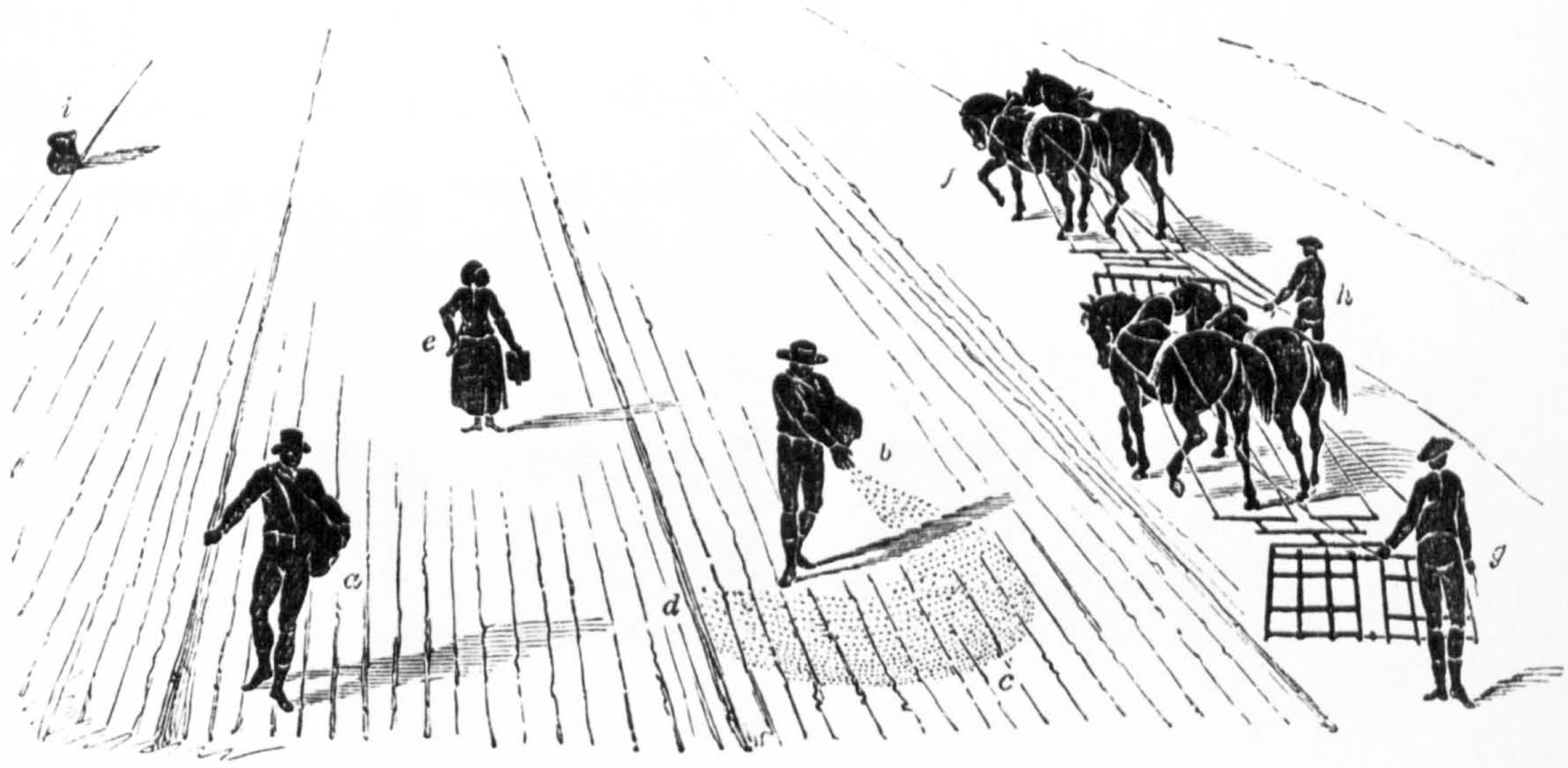
41. Sinclair, Account, vol. 1, pl. 164-165 note.

A second factor influencing output was the seed-rate. Cereal crops were thickly sown. "A man does a good days work if he sows broadcast 16 imperial acres of ground in 10 hours, that is, scatters 80 bushels of potato oats and 96 bushels of common oats in that time. Some men can sow 120 bushels of common and 100 of potato in that time, that is, 20 acres: and double-handed sowers can sow more than this"[42]. Productivity sowing grass-seeds was higher. Stephens recalls, "On making one of a party of three, who in sowing one day, 72 acres imperial (24 acres to each) with three casts to every ridge of 15 feet in width, I believe I did as great a days work in this business, as most people ever did"[43]. We shall adopt a uniform coefficient of 16 acres per man-day, since this agrees best with later estimates[44].

This output could only be achieved if the sower were kept constantly supplied with seed. One seed-carrier was enough to supply 2 sowers, 2 could supply 3 sowers[45], (Figure 2.4). Hard on the sower's heels followed the harrows, to cover the seed. Two sowers worked fast enough to keep two harrows employed (double harrowing) or 4 harrows if a single harrowing was thought sufficient[46].

42. Stephens, Book of the Farm, vol. 2, p. 519.
43. ibid, vol. 2, p. 519.
44. eg. Morton, op. cit., p. 105.
45. Leslie, General View Nairn and Moray, p. 127.
46. ibid.

Figure 2.4



Sowing corn by hand, with the harrows in the field.

a Leading hand-sower
b Second hand-sower
c Elliptical form of the cast of seed.
d Open furrow between the 2 ridges.
e Field-worker for carrying seed to the sowers.
i Sack of seed-wheat,
f Leading pair of horses.
h Leading pair of harrows.
g Following-man with his pair of horses and harrows.

The total labour input required to sow 16 acres broadcast was, therefore, 3.50 man-days, which gives a labour coefficient of 0.35 mandays per acre.

Sowing in Bengal took longer, even where seed was broadcast, not transplanted. It took one man a day to sow a _bigha_ broadcast, or 3 mandays to sow an acre[47]. Transplanting was highly labour intensive. One modern source estimates it takes 4 men 6.5 hours to transplant 0.33 acres[48]. This gives a labour input per acre of 13.00 mandays[49]. We shall take the middle estimate of transplanting one acre of paddy as 13.00 mandays.

Seeds for transplanting were sown first in a nursery. A quarter _bigha_ of seedlings were sufficient to transplant 2 _bighas_, (0.66 acres) of _boro_ rice[50]. The area required to be transplanted for a nursery was, therefore, 12.5% of the total area to be transplanted. Since 3.00 mandays were required to broadcast one acre, the labour input to sow a nursery sufficient to transplant one acre will be 0.37 mandays.

47. Carstairs, _Condition of the Ryots_, p. 9.
48. Battacharya, p. 90.
49. Carstairs, _op. cit._, p. 9; Seton-Karr, "Agriculture in Lower Bengal", p. 427.
50. Sen, _Report on Dacca_, p. 32.

2.1.3. Harvesting.

This, the most labour-intensive farming operation, underwent a major technological change between 1790-1840. No less than three different tools were in use. Traditionally, all grains were cut by the sickle, of which there were two types, the serrated or toothed sickle and the smooth sickle or scythe-hook. By the 1790's, the smooth sickle was that in general use, and by the 1840's this in turn had been replaced by the scythe. The relative productivity of these three tools is given below.

TABLE 2.2

OUTPUT PER MAN-DAY: SCYTHE, SMOOTH SICKLE, SERRATED SICKLE

	WHEAT (acres)	OATS/BARLEY (acres)
Scythe	2.33	4.12
Smooth sickle	1.36	2.56
Serr. sickle	1.05	2.06

Source: John Taylor, "On the Comparative Merits of different modes of reaping grain", Prize Essays and Transactions of the Highland Society of Scotland, (1843/5), p.263.

Clearly, the scythe improved labour productivity; in some cases, by over 60%, if we are to believe these figures. The difference between types of sickle was much less, at only 20%. This is confirmed by the contemporary comment that "it required four always on a ridge, with the common sickle, to keep up with three hands working with the hook, on a ridge the same on every respect with the other"[51]. One disadvantage was time lost in sharpening. One farmer complained that "among ten rigs of shearers (reapers), there will not be, perhaps, above three of four efficient sharpeners; and before the end of the harvest, scarcely a bit of stone fit for the purpose can be produced among the whole band, while the employer has the mortification of seeing perhaps fully a third part of their time consumed in fruitless attempts to sharpen their sickles"[52]. Real productivity gains might therefore have been slight.

Output per reaper is an artificial unit since harvesting with the sickle was always a co-operative task, as these examples show (See Fig. 2.5). "Four reapers are

51. Anon, "Remarks on the Scythe-Hook, as compared with the sickle". Farmers Magazine, vol. LXXXIX, (Fed, 1822), p. 57.

52. Anon, "On reaping Hooks", Quarterly Journal of Agriculture, vol. 3, (1831-2); Miscellaneous Notices, No. XXIII, p. 1082.

Figure 2.5

Reapers in a bandwin.

f a e First ridge in bandwin.
d c g Second ridge in bandwin.
a Man making a band.
b Band laid down.
c Man reaping.
d Leading reaper on second ridge.
e Reaper clearing the furrow of corn, leaning on the right leg.
f Leading reaper on first ridge, leaning on the left leg.
g Reaper going to lay sheaf on band.
h Sheaf ready for binding.
i First 2 sheaves of stook.
k Bandster and stooker carrying sheaves to stook.
l Provisions.

expected to cut a Scotch acre per day, at the average rate ofworking". "A man binds to eight reapers, who generally cut two Scotch acres a day"[53]. This gives a coefficient of 3.1 man-days per acre. But productivity depended also on the nature of the grain - wheat took 4.7 man-days per acre - and seemingly the breadth of the ridge[54]. Three reapers on a 15 foot ridge were a match for four on an 18 foot one[55].

After cutting the stalks were gathered in bundles, tied with a band of straw into sheaves, and stooked. Binding and stooking were usually combined activities. One source puts output as high as 2.54 acres per day, (See Table 2.2 above), but this is certainly an overestimate; another puts output as low as 1.00 acre[56]. Elsewhere, it is stated unequivocally that "when 5 reapers are expert in using the sickle, it is hard labour for the binder"[57].

53. Samuel Smith, General View of the Agriculture of Galloway, (London, 1810), p. 304; Robertson, General View of Midlothian, p. 94.

54. "Letter from a Young Farmer to his Father". Farmers Magazine, vol. 8, (1807), No. XXXI, p. 371.

55. Sinclair, Account, vol. 2, pp. 159-60.

56. James E. Hunter, "Report on Machine Reaping". Transactions of the Highland and Agricultural Society of Scotland, (1853-55), No. XIX, p. 195.

57. Donaldson, Modern Agriculture, vol. 2, p. 415. See also James Roger, General View of the Agriculture of Angus or Forfar, (London, 1794), p. 19.

This seems to have been the accepted average. We therefore adopt 1.58 acres as the area 6 people could bind and stook in a day.

Changes in task organisation did affect output in our period, as piecework became increasingly common. "Threaving" meant that cutting, binding and stooking were all performed by one person. Although advocates of the system claimed otherwise, it is clear this did not raise productivity. As we know, 6 people could cut, bind and stook 1.58 acres per day, giving a labour input of 3.77 man-days per acre. The hourly rate was therefore 152.72 sq. yards for cutting and 704.72 sq. yards for binding and stooking. At these rates, it would take 12 hours to cut, bind and stook 0.31 acres, or "threave" at the rate of 126.01 sq. yards per hour. Output per man-day of ten hours will therefore be 0.26 acres, giving a labour input of 4.00 man-days per acre.

Threaving was adopted not because it raised labour productivity - on average, productivity fell - but because of labour shortage. As one enthusiast wrote: "formerly none were hired but full-grown persons, who had leisure from their other occupations, to engage for the whole harvest; but those may act as threavers, who can spare a day or two, or even a few hours of the day. The assistance of children, just able to wield a hook, is obtained..."[58]. Piece-work effectively mopped up the residual pools of labour in a tightening labour market.

By contrast, the scythe clearly did raise labour productivity. The Table below shows various contemporary estimates.

Table 2.3

ACRE OUTPUT PER MAN-DAY WITH SCYTHE

(1) WHEAT	(2) OATS/BARLEY	(3) HAY/CLOVER
1.16	2.06	3.00
1.00	2.00	2.00
0.75		1.00
		0.75

Sources: (1) and (2): John Taylor, "On the comparative merits of different modes of reaping grain", THASS, New Series, 1843-5, p.263 Henry Stephens, Book of the Farm, vol. 3, p. 1065. Primrose McConnel, Notebook of Agricultural Facts and Figures, (London, 1883), p. 80; (3) 2-3 acre estimates from Anon, Observations on West of England Husbandry, Farmers Magazine, No. XLVii, (July, 1811), p. 470.

58. M. N. "On Threaving; or a New Mode of Paying for Reaping Corn, according to the extent of work executed". Farmers Magazine, vol. 6, (1805), No. XXiV, p. 466.

Man-days may not have been uniform, and variation in the quality of the crop was obviously important. As an average, the claim that "a man, accustomed to use the scythe, will go over as much ground in a day as four reapers are able to do", seems right[59]. We adopt the coefficients of 1.00 (wheat), 2.00 (oats/barley), and 1.00 (ryegrass/clover), acres per man-day.

These productivity gains meant changes in task organisation, (See Fig. 2.6). The commonest form was "two mowers require five attendants, viz, two gatherers, two binders and one raker". It was the job of the gatherer, generally a woman, to follow each scythe, to make bands and take up the corn, and place it in bundles ready to be bound up; a bandster [binder] always a man, follows the women and binds the sheaves; the two bandsters set up the corn together into stooks; a woman follows the whole with a large rake, and cleans the ground of any loose corn, and brings the rakings to the bandsters, to be bound up in the sheaves by themselves..."[60].

A variant form of task organisation prevailed in Midlothian, where 2 men mowed, a girl made the bands, and

59. Donaldson, Modern Agriculture, vol. 2, p. 414.

60. Anon, "On Reaping with the Scythe", Quarterly Journal of Agriculture, vol. 4, (1832-4), No. XLI, p. 359.

Figure 2.6

Mowing corn with the scythe.

a a a Swathes of corn.
b b b 3 mowers.
c c c 3 gatherers.
d d Open sheaves.
e Bandster binding a sheaf.
f f Bandsters setting a stook.
g Stook.
h Man raker.
i Hand stubble-rake.
k Bound sheaf.

a man bound the sheaves. Here the place of the second male binder was evidently taken by the reaping fork which the girl used to form the sheaves. "There can be no question that, with this implement, corn can be collected faster and more regularly into sheaves, than merely by hand labour"[61]. Here, innovation seems to have been a direct response to a shortage of male labour.

In general, however, it took a group of seven people to mow, bind and stook 2 acres[62]. Two factors tended to reduce productivity. Output per binder was reduced: he "binds less in a day to the scythe than to the sickle, because he binds to but one scythe", whereas, with the sickle, a binder serves "six shearers, who reap more in a day than one scythe". On the other hand, he was not sufficiently under-employed for a third mower to join the band: "two acres, or very little more, is as much as can be done; the mower might do more, but this is as much as the attendants can gather, bind and stook, and a third cannot be employed to advantage"[63]. Maximum output for a band of 7 is thus 4 acres, giving a labour input of 1.75 man-days per acre.

61. Robertson, General View of Midlothian, p. 74.

62. John Taylor, "On the Comparative Merits of different modes of reaping grain", Prize Essays and Transactions of the Highland Society of Scotland, N.S, (1843-45), p. 263. Anon, "On Reaping with the Scythe", p. 359, No. XXXll.

63. Taylor,"Comparative Merits", pp. 259-260.

Despite this level of productivity, the scythe was slow to spread. As late as 1812, in the Forth Valley it was reported that "Reaping with scythes is rarely practiced in this county; the whole grain is mostly cut down with the sickle"[64]. Conservatism apart, why were farmers unwilling to adopt a technology offering clear productivity gains? Firstly, we must recall that this relatively high level of output did not apply to wheat. The reasons are unclear. Possibly, the shorter straw made it more difficult to mow[65]. In any case, changing cropping patterns would prevent diffusion of the scythe, as wheat replaced the coarser grains. But the most convincing explanation is surely labour shortage. The new tool had one major disadvantage: "The scythe can only be used by men, the sickle by both men and women"[66]. Indeed, by children. "From the stripling of fifteen, to his decrepit grandmother, all wield the new fashioned (smooth) sickles"[67]. In the competitive labour market of the early nineteenth century, a technology which moblised labour was at a premium; one which merely raised productivity was at a discount.

64. Robertson, General View of Perth, p. 187.

65. Kames, The Gentleman Farmer, p. 160.

66. Stephens, Book of the Farm, vol. 3, p. 1050.

67. Anon, "On Reaping Hooks", p. 1082.

The labour coefficients of smooth sickle, serrated sickle and scythe are thus 3.1, 2.32 and 1.75 man-days per acre respectively.

Harvesting in Bengal involved three separate operations of reaping, drying and binding. The grain had then to be carried to the threshing floor. One estimate for Burdwan put the labour required to reap one <u>bigha</u> at 7 hours, giving a labour input per acre of 3.50 man-days[68]. A modern estimate puts the tasks of reaping and carrying as 13 hours per <u>bigha</u>, or 6.50 man-days per acre[69]. A fuller account of the operation suggests both are underestimates.

> "Reaping depends more than any other process on the quantity of water on the ground. To reap, lay down to dry, bind and carry to the homestead, when the ground is dry, as is usually done with the best rice and the inferior rice on a higher level, takes on an average from six to eight days labour (per <u>bigha</u>). For the low ground, the cost is given at amounts varying from this up to 16, and in one case, up to 19. It may be taken that the cost of harvest is doubled by the crop having to be reaped in water"[70].

68. Sen, <u>Report on Burdwan</u>, p. 15.
69. Battacharya, p. 91
70. Carstairs, "Condition of the Ryots", p. 10.

We shall therefore adopt the estimate of 21.00 man-days per acre for harvesting, which agrees with the latest modern estimates[71].

2.1.4. Threshing.

In contrast to Bengal, the traditional method of threshing grain in Scotland was by hand, with the flail. Output data is available for the Forth Valley in the experiments of Erskine of Mar. Two men thrashed 3.75 bolls in a day of 8.5 hours, but this estimate is down-rated because the grain was not properly fanned to 3.50 bolls. One man therefore thrashed 1.75 quarters, or 0.205 quarters per hour[72]. This may be compared with other contemporary estimates. "Two men in 8 hours thrashed nine thraves of victual with a flail, producing 3 bolls, 3 firlots, and one peck of grain..."[73]. Assuming a Stirlingshire boll, this gives a total of 1.25 quarters or 0.156 quarters per hour. Again, in Roxburghshire, we are told that a man will thresh 1.25 bolls in a day of 10 hours, but this includes bundling the straw. Converted, output is 1.18 quarters. Later estimates are much higher

71. Costs and Returns Survey for Bangladesh, 1978-79 Crops. Agro-Economic Research Section, (Dacca, 1979), vol. III, T. Aman paddy. p. 41, Table A5.

72. Erskine, General View Clackmannan, p. 129.

73. Graham, General View of Clackmannan, p. 246.

for oats: as much as 4 quarters per man-day of 8 hours, or 0.5 quarters per hour. Output for wheat is much the same at 1 quarter (0.125 per hour), and barley at 2 quarters (0.25 quarters per hour). The figures are set out below.

Table 2.4

OATS		WHEAT		OATS/BARLEY		BARLEY	
0.205	(a)	0.125	(d)	0.156	(e)	0.25	(g)
0.50	(b)			0.125	(f)		
0.13	(c)						

Sources: (a) J. F. Erskine, General View of the Agriculture of the County of Clackmannanshire, (London, 1794) p. 179, (b) Primrose McConnel, op. cit., p. 81, (c) Robert Douglas, General View of the Agriculture of Roxburgh and Selkirk, (London, 1798), p. (d), (e) McConnell, ibid, (f) P. Graham, General View of the Agriculture of Stirling, (London, 1812), p. 246; (g) George Robertson, General View of the Agriculture of Midlothian, (London, 1793), p. 94.

Generally, there seems to have been a 75% variation in productivity between grains. We shall adopt coefficients of 1.50 quarters (oats), 1.25 (barley and 1.00 (wheat) per man-day.

Productivity data for machine threshing is available for the Forth Valley from Erskine's experiments with 4 and 6 horse power machines.

Table 2.5

HORSE-POWER	NO. SHEAVES	NO. QUARTERS	QTRS. PER HOUR	QTRS. PER DAY
4	228	2.88	10.52	29.75(rev)
4	228	2.80	12.01	
4	228	2.69	11.98	
6	228	2.74	12.17	47.60(rev)
6	228	2.78	15.21	

Source: J. F. Erskine, "An Account of a Comparative Trial of Five Thrashing-Mills in the County of Clackmannan", *Farmers Magazine*, vol. 14, p. 179, (1813).

Erskine was a careful observer who tried his best to ensure comparable results. He used the same horses, oats from the same field, and the same man fed the sheaves into the machine. Nor does he try to conceal the limitations of his experiment; "as it was known that this was a trial of different mills, the people employed grew very keen, and everyone exerted himself. The horses could not have continued to work at the same rate for an hour"[74] Accordingly, he revised his estimates downwards.

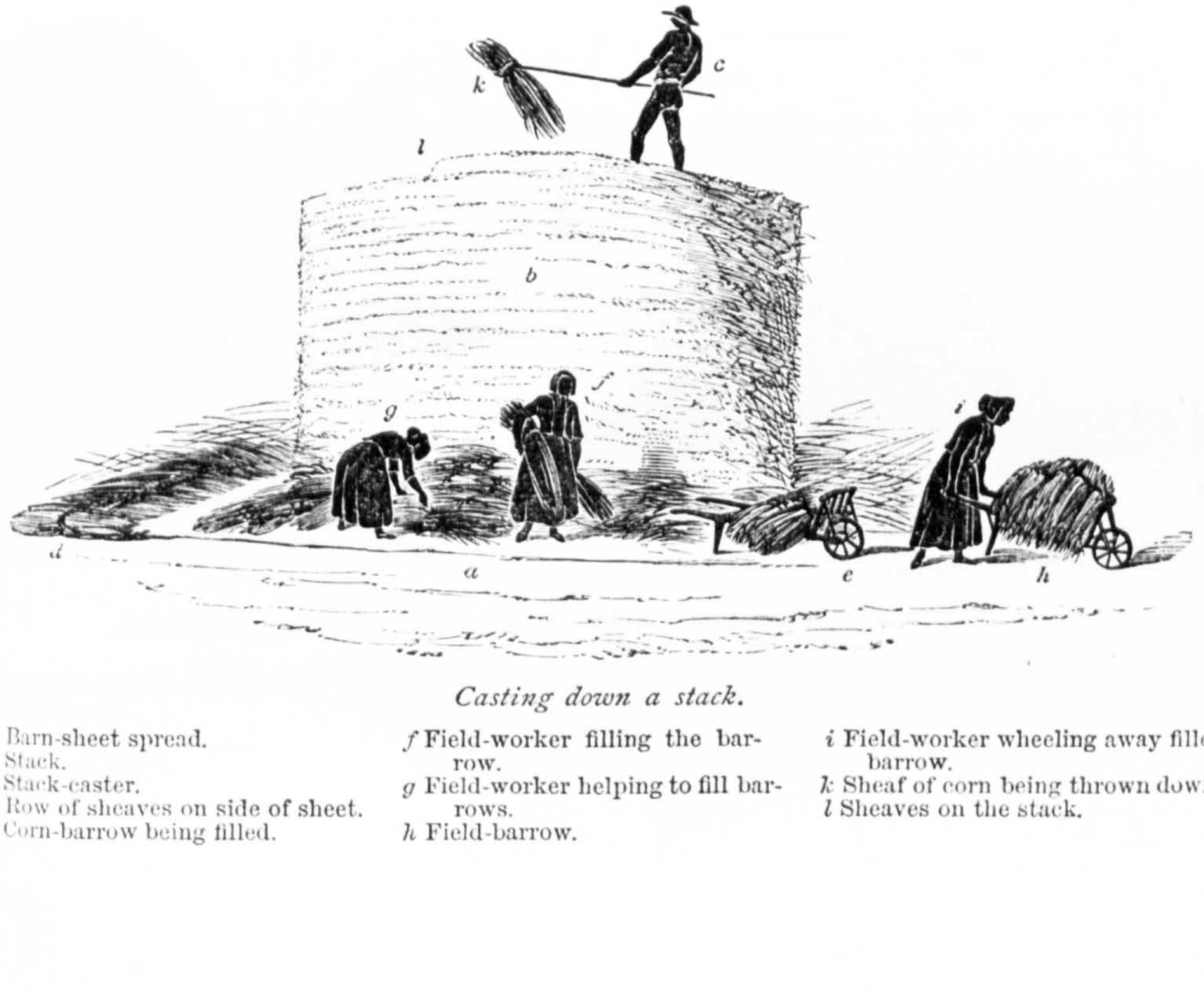
74. Erskine, *op. cit.*, p. 179.

The size of the mill determined task organisation which in turn determined labour productivity. Fortunately, we can study this in some detail. Many people were involved., (See Fig. 2.7). The stack of corn in the farmyard had first to be "cast", or taken into the barn: one man was therefore required to pitch down the sheaves, a woman to load them onto barrows, and two women to wheel them across the yard to the barn, where a fourth waited to pile the sheaves into parallel rows or "mows". Only then could threshing begin, (Fig. 2.8).

Two women brought forward the sheaves, loosened the bands and placed them on the feeding-in board. The feeder (usually the head servant or grieve) had the most responsible job, since he controlled the speed of the machine. As the corn was threshed, two men were needed to take away the straw from the screen of the mill and fork it across the barn into mows. Meanwhile, two more women were hard at work riddling the corn as it came out of the spouts. Down below, the ploughman led the six horses. Altogether, therefore, a total of 13 men and women, 5 casting the stack and 8 tending the machine[75].

75. Stephens, Book of the Farm, vol. 1 pp. 304.

Figure 2.7



Casting down a stack.

a Barn-sheet spread.
b Stack.
c Stack-caster.
d Row of sheaves on side of sheet.
e Corn-barrow being filled.
f Field-worker filling the barrow.
g Field-worker helping to fill barrows.
h Field-barrow.
i Field-worker wheeling away filled barrow.
k Sheaf of corn being thrown down.
l Sheaves on the stack.

Figure 2.8

Feeding in sheaves into the thrashing-machine in the upper barn.

a Sheaves mowed up from the stackyard.
b Rake.
c Refuse on floor.
d Feeder-in of corn.
e Feeding-in board.
f Field-worker loosening sheaves.
g Field-worker bringing forward sheaves from the mow.
h Wecht.
i Broom.

Task organisation might vary, but not apparently the numbers employed. Thus, in the Forth Valley, 3 not 2 men forked the straw, but one man was considered sufficient to riddle the grain[76]. Other estimates give 10 men or women as the number needed, but this may refer to 4 horse-power mills[77]. It seems wise to assume that 13 was the maximum since, as one farmer remarked, "many farmers endeavour to dispense with so many hands, as employing one to loosen the sheaves, and one to riddle the grain in the corn barn"[78]. We shall adopt a total labour input of 10 for both 6 and 4 horse-power mills. Two-horse power mills required less. In Roxburghshire, only 6 were necessary, because one woman was sufficient to riddle the grain, and one man or woman was enough to take away and stack the straw[79]. Labour productivity is shown in the Table below.

76. Erskine, op. cit., p. 183.

77. Graham, General View Stirlingshire, p. 115; Sinclair, Account, vol. 1, p. 437, note.

78. Anon, "On Barn Management", Quarterly Journal of Agriculture, vol. 3, (1831-32), Miscellaneous Notices, No. XXlll, p. 991.

79. Robert Douglas, General View of the Agriculture of Roxburgh and Selkirk, (London, 1798), Addenda, p. 368.

Table 2.6

OUTPUT PER MANDAY WITH MACHINE THRESHERS

HORSE-POWER	NO. EMPLOYED	OUTPUT(QRS)
6	8	29.68
4	8	47.60
2	6	20.10
2	6	9.42

Source: J. F. Erskine, *op. cit.*, p. 179. Robert Douglas *op. cit.*, p. 368.

The average output for a two-horse mill was, therefore, 14.76 quarters (42.943 hectolitres) per man-day. Six people were required to operate the machine. Average output per man-day was thus, 7.15 hl. Since farms in the Forth Valley were generally small and the majority employed two horses, it seems likely that two horse power threshing machines predominated. We therefore adopt a labour coefficient of 7.15 hl. per man-day for machine threshing.

Before the grain could be sold, however, it had first to be winnowed. This was done with a fanning machine. Task organisation required one man and four women, (See Fig. 2.9). "The steward drives the blower. One woman fills the hopper with corn with a large wecht

Figure 2.9

Winnowing corn.

a Fanner.
b Driver.
c Woman feeding the hopper.
d Woman taking up corn.
e e Women riddlers.
f Corn-basket.
g Wooden shovel.
h Besom.
i Light corn.
k Chaff.

from the heap, on the opposite side from the driver. Her duty is to keep the hopper as nearly full as she can, as then the issue of corn from it is most regular. Another woman, with a smaller wecht, takes up the good grain as it slides down at the end, and divides the wechtful between the other two women who stand with a riddle each in her hand at the place where the new heap is to be made"[80]. Grain was normally put once through the fanner, riddled, put through again, then riddled a second time. One estimate puts the output of three people winnowing at 3 quarters per hour, which gives a coefficient of 30 quarters per man-day[81].

Finally, the grain was measured and put in sacks ready for delivery to market. The operation is shown in Fig. 2.10. Once again, the steward and four women were required. An estimate for the whole process of winnowing and measuring puts output at 22 quarters per day[82]. Output per man-day is thus 5.5 quarters, (16.00 hl per man-day).

80. Stephens, Book of the Farm, vol. 2, p. 273.
81. Leslie, General View Nairn and Moray, p. 125.
82. Anon, "On Barn Management", p. 997.

Figure 2.10

Measuring up corn in the corn-barn.

a Measurer of corn.
b Bushel.
c c Women filling bushel.
d d Women holding the sack.
e Sack being filled.
f Sack-barrow.
g Filled sacks.
h Empty sacks.
i Heap of corn.
k Wooden shovel.
l Besom.

A number of estimates are available for threshing, but task organisation differed according to the nature of the crop. "The paddy reaped dry is generally threshed by dashing the bundle against boards till all the grain is separated. Paddy reaped wet is trampled out by oxen"[83]. Task organisation for the first of these methods was as follows: "Threshing is performed on a slanting wooden platform placed on a tripod stand. The threshing is done by holding a bunch of hay with both hands and striking the bunch over the platform. The straw is then thrown to a side. Two full days are needed for a man to thresh the harvest of a <u>bigha</u> of land"[84]. This gives a labour input of 6.00 man-days per acre for hand thrashing.

Task organisation with bullock thrashing was equally simple. Bundles of rice were stacked on the earth threshing floor, and spread out in a circle round a vertical piece of bamboo about four feet long fixed in the centre. Bullocks were then made to walk round and round over the rice until the straw was thoroughly broken and all the grain separated from the heads. Productivity varied according to the number of bullocks employed. Various estimates are available. "The total quantity of grain trodden out by

83. Carstairs, "Conditions of the Ryots", p. 8.

84. Battacharya, p. 91.

three pairs of bullocks in seven days was thirty-seven and a half maunds"[85]. This gives an output per bullock-pair-day of 0.682 hectolitres. Another estimate, this time for four bullocks, estimates output at 1.866 hl. per bullock-pair-day[86]. In Burdwan district, it was reported that four or six oxen could tread out the produce of half a bigha, (0.16 acres) in 3 hours[87]. This is equivalent to 18 hours for one acre, or six-bullock-pair-days per acre. Other estimates for Birbhum suggest that it took 6 man-days to thrash one acre, but do not specify the number of bullocks involved. Output per day of 2.799 hl suggests that 4 bullocks were used, giving an output of 1.399hl. per bullock-pair-day[88]. A comparison of these figures suggests that 3 bullock-pair-days per acre is a reasonable average for bullock thrashing.

85. E. Shearer, "Steam Thrashing in India", Agricultural Journal of India, vol. 2, pt. 111, (1907), p. 248.

86. Montgomery Martin, The History, Antiquities, Topography, and Statistics of Eastern India collated from the original sources. (London, 1838), vol. 3, p. 226 (Purniya).

87. Sen, Report on Burdwan, p. 16.

88. Barawan Thana, p. 44. Assuming yield per acre of 25.194 hl. Hunter, SAB, vol. 4, p. 351 (Birbhum).

Winnowing was done with a fan. "This is effected by lifting a quantity in a basket and gradually letting it fall to the earth, while a moderate wind is blowing. The grain falls on the ground, while all imperfect grain and intermixtures, being lighter, are blown away to a distance"[89]. Wind was not always necessary forwinnowing, however . "The paddy is taken up in a flat scoop and thrown up so as to fall on the heap, gravity causes the grain to fall under the chaff, which is then fanned off with the scoop. Two men ply the fans after each quantity of grain thrown on, and the work is one in which skill makes a great difference"[90]. The combined labour input for thrashing and winnowing was estimated at 9 mandays peracre[91]. We shall, therefore, adopt a labour coefficient of 3.00 mandays for winnowing.

89. Hunter, SAB, vol. XV, pp. 284-285 (Purnea).

90. Carstairs, Condition of the Ryots, p. 11.

91. ibid.

2.1.5. Miscellaneous.

A number of miscellaneous coefficients remain. First, manuring. Estimates of cart capacity for Scottish agriculture are shown in Table 2.7 below.

Table 2.7

OUTPUT PER MANDAY, MANURING

LOAD (kg)	NO. PER DAY	OUTPUT P/HOUR	OUTPUT P/MANDAY
(1) 685.83	19.5	1543.11	15431.19
(2) 1146.79	15.0	1720.18	17201.85
(3) 792.85	20.0	1585.71	15857.12

Sources: (1) P. McConnell, op. cit., p.79 (2) Farmers Magazine, (1807), p. 368. Lowe, General View of the Agriculture of Berwickshire, p. 35-6. (3) (4) J. F. Erskine, p. 33.

Although Erskine's figures for cart-capacity are well below other contemporary estimates, he seems unlikely to be wrong. We have already found him reliable, and it is noticeable that his figure for the largest 2 horse cart is very close to that of the 1880's. Averaging estimates, (1) and (3) give an output of 15644.15 kg per man-day. In the Forth Valley a man could therefore fill 33 carts per day. He is required to load, cart and unload 40 cartloads. We know that 3 men loading can keep 2 carts constantly employed[92]. Assuming that boys are employed to lead the carts, 46932.45 kg. of manure can be loaded, carted and unloaded in 8 man-days. At the rates applied in the Forth Valley, this will be sufficient for 2.51 acres, which gives a labour coefficient of 3.18 man-days per acre[93].

The normal number of spreaders was 4 for each "head" of 4 carts, or one to each cart. We are told that these 4 carts carry a total of 60 loads per day, which means that one person can spread 17201.85 kg[94]. In the Forth Valley, the rate is 18676 kg. per acre. Hence this will take 10.85 hours or 1.09 man-days. We should also add the time spent in preparing the manure. Loading manure from the byre, carting to the dungheap and unloading will occupy a second 3.18 man-days per acre. The dung was turned, usually twice, which gives a further 0.71 man-days[95]. The total for spreading one acre of manure is, therefore, as follows:

92. Morton, op. cit., p. 68.

93. 30 cartloads NSA, vol. 8, p. 328 (Falkirk). One cartload = 466.90 kg. = manuring rate 18676 kg. per acre.

94. "Letter from a Young Farmer", Farmers Magizine, vol. 8 '1807), No. XXXi, p. 368.

95. Morton, Cyclopedia, vol. 2. p. 181.

Filling:	3.18
Turning:	0.71
Filling:	3.18
Spreading:	1.09
	8.16

Finally, we must take into account time spent "leading in the corn" from the field to the stackyard. From wage data, we can establish that 3 men can load, build and unload one acre of corn from field to stack in 0.42 man-days, giving a coefficient of 1.26 man-days per acre. Two men can stack the produce of an acre in 0.50 man-days, while an additional man-day is required for carting[96]. The grand total is 2.76 man-days to lead in one acre of corn.

The normal estimate for manuring in Bengal was 2 man-days per bigha for a load of 25 maunds (9.25 hl). If the rate of manuring was 30 hl. per acre, then the labour coefficient per acre was 6.00 man-days[97].

Weeding was an important cultivation practice in Bengal. Two weeding implements are mentioned in Burdwan: a weeding hook (phor) and the pushuni, which resembled

96. Morton, op. cit., p. 111: Mc Connell, op. cit., p. 33.

97. Carstairs, "Condition of the Ryots", pl. 89.

the European hand hoe[98]. It was estimated for nineteenth century Bengal, that "to weed only a quarter of a beegah would be an extremely good day's work"[99]. This is equivalent to 0.08 acres per day, giving a labour input of 12.50 man-days per acre. A modern estimate is that 9.75 hours labour is sufficient to weed one higha, which gives only 4.87 man-days per acre[100]. We take the conservative estimate of 12.50 man-days per acre.

Other miscellaneous practices included the repair of the embankments or ails surrounding the paddy fields. Since we have no historical evidence of the labour input for this task, which was essential for aman, we use the modern figure given for the practice of 5.90 man-days per acre[101].

98. Sen, Report on Burdwan, pp. 8-9.
99. Seton-Karr, "Agriculture in Lower Bengal", p. 426.
100. Battacharya, p. 91.
101. Costs and Returns Survey, vol. 111, p. 21, Table A.5.

Table 2.8

LABOUR COEFFICIENTS: SCOTLAND

CULTIVATION ACTIVITY				MAN-DAYS PER ACRE
(1)	Ploughing			1.25
(2)	Harrowing	(single)		0.16
		(double)		0.32
(3)	Rolling			0.08
(4)	Sowing			0.35
(5)	Harvesting:	reaping binding stooking		3.1 (sickle: serrated) (2.32 smooth)
		threaving		4.00
		mowing binding stooking		1.75
(6)	Threshing:	flail:	wheat	2.43
			barley	3.32 (carse)
			oats	2.73 (carse)
		machine:	wheat	1.48
			barley	1.68 (carse)
			oats	1.66 (carse)
(7)	Winnowing and measuring:		wheat	0.66
			barley	0.75
			oats	0.74
(8)	Manuring:	filling		3.18
		turning		0.71
		filling		3.18
		spreading		1.09 -8.16.
(9)	Leading in the corn			2.76

Table 2.9

LABOUR COEFFICIENTS, BENGAL

CULTIVATION ACTIVITY			MANDAYS PER ACRE (6 hrs.)
(1)	Ploughing		3.00
(2)	Harrowing		0.33
	Laddering		0.33
	Raking		0.33
	Rolling		0.33
(3)	Sowing		3.00
	Sowing Nursery		0.37
	Transplanting		13.00
(4)	Weeding		12.50
(5)	Ha rvesting:	reaping binding carrying	21.00
(6)	Threshing:	dry paddy	6.00
		wet paddy	3.00
(7)	Winnowing		9.00
(8)	Manuring		6.00
(9)	Repairing embankments		5.90
(10)	Irrigation		9.00

Section 2: labour inputs.

We now move on to compare the labour inputs for particular crops. Seven crops have been selected for the Forth Valley, (wheat, barley, oats, peas and beans, ryegrass/clover, turnips, and potatoes), and nine for Bengal, (aus, aman, boro, wheat, gram, oilseeds, jute, sugar and tobacco).

In both cases, labour inputs have been determined by multiplying labour coefficients against the cultivation practices as they existed in each region. Where this has proved impossible from the existing sources, we have used data from other regions.

Practice naturally varied immensely between regions. A compendium of the cultivation techniques for a single crop - potatoes - reveals an extraordinary range of labour inputs[102]. Variations between regions are to be expected, and can readily be explained on scientific grounds. But it is equally clear that there was little uniformity within regions, either. Techniques differed even on neighbouring farms. "In one place oats, barley and even wheat, are set up in single sheaves or gaits;

102. Report of the Committee of the Board of Agriculture appointed to extract information from the County Reports and Other Authorities, concerning the Culture and Use of Potatoes, (London, 1795).

in another, everything is in stooks; in a third, six or eight sheaves are made to lean on each other; and a little further on, you see the crop gathered up into small ricks of a cart-load, or less, as a preparation for the stackyard"[103]. Such variations make any regional average very hypothetical. This caveat applies a fortiori to Bengal, a far larger area.

2.2.1. Wheat.

This was always sown broadcast in the Forth Valley, and was always heavily manured. 40-50 cartloads of dung per acre is the estimate for 1812, and 30 single cartloads are mentioned in the 1840's[104]. We shall use the latter figure. Six ploughings were given[105].

Although references were found to the weeding of cereals in other countries such as East Lothian (Somerville, General View, p.114) no reference to this practice was found in Stirlingshire (Graham, General View, 146-198) and is therefore omitted from our estimates of labour inputs for cereals.

103. Anon, "Hints on Harvest Management", Farmers Magazine, No. LXVIII, (Nov, 1816), p. 453.

104. Graham, General View Stirlingshire, p. 148, NSA, vol. 8, p. 328, (St. Ninians).

105. OSA, vol. IX, p. 574 (St. Ninians).

Table 2.10

WHEAT: LABOUR INPUTS BY CULTIVATION ACTIVITY

CULTIVATION ACTIVITY	MANDAYS PER ACRE
Ploughing (6)	15.00
Harrowing (5)	1.6
Manuring	8.16
Sowing	0.35
Rolling	0.08
Harvesting	3.1
Leading in, stacking	2.76
Thrashing	2.43
Winnowing, measuring	2.61
	36.09

2.2.2. Barley.

A minimum of three ploughings was required, and six were sometimes given[106]. Four harrowings are stated as the norm[107]. In the carse, these intensive preparations had to be supplemented by manual labour. It was not uncommon "to see half-a-dozen of stout fellows in the fields, pulverising the unequal surface with mallets"[108].

106. Graham, op. cit., pp. 155-156; OSA, vol. lX, pp. 135 (Airth), 574 (St. Ninians); NSA, vol. 8, p. 328 (St. Ninians).

107. Stephens, Book of the Farm, vol. 2, pp. 630-631.

108. Carmichael, "Vale of Forth", p. 15.

We have not included this input, nor the handweeding which some writers recommended[109]. Manure was applied in the same quantity as to wheat[110]. Finally, after sowing the land was rolled[111].

Table 2.11

BARLEY: LABOUR INPUTS BY CULTIVATION ACTIVITY

CULTIVATION ACTIVITY	MANDAYS PER ACRE
Ploughing (5)	12.5
Harrowing (4)	0.64
Manuring	8.16
Sowing	0.35
Rolling	0.08
Harvesting	3.1
Leading in	2.76
Thrashing	3.32
Winnowing	2.72
	33.63

2.2.3. Oats.

Of all the cereal crops, oats required the least labour. In the Forth Valley, the land was only ploughed

109. Kames, Gentleman Farmer, p. 81.

110. Graham, op. cit., pp. 155-156.

111. ibid.

once. A "top-dressing" of manure was then applied: we assume this was equivalent to half the quantity applied to wheat[112]. Normally, the ground was not harrowed before sowing: those farmers who did so were remarked upon[113].

Table 2.12

OATS: LABOUR INPUTS BY CULTIVATION ACTIVITY

CULTIVATION ACTIVITY	MANDAYS PER ACRE
Ploughing (1)	2.25
Top-dressing	4.08
Sowing	0.35
Harvesting	3.1
Leading in	2.76
Threshing	2.73
Winnowing	2.71
	17.98

112. ibid, pp. 157-158.

113. Robertson, General View Perthshire, p. 185.

2.2.4. Peas and beans.

We have no information on the nunber of ploughings given in the Forth Valley. The recommended practice was to plough the land before winter to keep it dry. Come the spring, it was harrowed twice, cross-ploughed, and harrowed four times[114]. The seed was then sown, with the drill machine following the plough[115]. This drill might have been either horse-drawn or a hand drill, but we have no estimates of the labour inputs[116]. The crop was hand-hoed twice in early summer[117]. Harvesting was by the sickle and the crop was allowed to lie on the ground for a few days, then turned. When dry, it "was tied in small sheaves, and set upright"[118].

114. Stephens, Book of the Farm, vol. 2, p. 545.

115. NSA, vol. 8, p. 15, (Falkirk).

116. Anon, "Account of an improved Mode of Raising Crops of Grain by Means of a Drill-Barrow", Farmers Magazine, vol. 16, (1915), No. LX1V, p. 437.

117. NSA, vol. 8, ibid.

118. Robertson, op. cit., p. 176.

Table 2.13

PEAS AND BEANS: LABOUR INPUTS BY CULTIVATION ACTIVITY

CULTIVATION ACTIVITY	MANDAYS PER ACRE
Ploughing (1) (3)	7.5
Harrowing (2) (6)	0.96
Drilling	0.1
Sowing	0.35
Hand-hoeing	4.5
Harvesting	3.1
Leading	2.76
Threshing	2.56
	21.83

2.2.5 Ryegrass/clover.

Hay - artificial grass- was the chief fodder crop in the Forth Valley. Ryegrass and clover were always sown together, either as a separate crop or mixed with oats[119]. We shall assume that it was sown with oats, and simply calculate labour inputs for harvesting.

119. OSA, vol. 1X, p. 635, (Strathblane).

Hay was always cut with the scythe, but otherwise task organisation in haymaking varied widely and changed over time. Throughout, however, the object remained the same: to dry the hay before stacking, and thresh enough ryegrass to obtain seed for the next crop.

The changes over time are not easy to determine. Those we know about were justified as labour saving. Cutting the hay when dry, for example, "does not require above one half of the work that is necessary in the old methods of turning and tedding it"[120]. Again, binding and stooking were condemned as "near double the charge of lap-cocking"[121]. Despite this, it is clear that haymaking in 1840 remained highly labour intensive. The recommended form of task organisation was as follows. After mowing, the hay was put into grass-cocks" which were spread the next day and built up into hand-cocks". These, in turn, were spread the following day and then built up into "ricks " or "colls". The alternative method of drying hay by raking it into "windrows" was an English form of task organisation not practised in Scotland[122].

120. James Anderson, Essays Relating to Agriculture and Rural Affairs, (Edinburgh, 1777-96, 2nd ed.), Vol. 1, Essay V, p. 251.

121. Anon, "On Hay Harvest, and the Hay best adapted for that Purpose", The Scots Farmer, vol. 2, (March, 1774), No. XXX., p. 225.

122. Stephens, Book of the Farm, vol. 2, pp. 968 ff.

Labour inputs are not easily measured. The Table below gives approximate weights for each of the stages in the drying process.

Tablé 2.14

HAYMAKING

TERM	WEIGHT(kg)	MANDAYS PER ACRE
grass cock	41.91	1.33
hand cock	142.50	1.33
rick/coll	498.95	1.33
tramp pike	1247.37	3.99

Source: Henry Stephens, Book of the Farm, vol. 2, pp. 968 ff.

We adopt a coefficient of 1174.00 kg as the weight of hay one person could spread and build in a day[123]. The yield of hay varied considerably, but the average in the Forth Valley was 1570.57 kg per acre. Hence, 1.33 mandays per acre are required for each stage.

Once the ricks had been built, thrashing began. One form of task organisation is shown in Fig. 2.11. The hay was dragged to the threshing floor by horses.

123. ibid, p. 969.

Figure 2.11

Thrashing ryegrass seed in the field, either in sheaf or in bulk.

a Horse bringing hand-cocks.
b Raker.
c Worker supplying hay to thrashers.
d e Thrashers.
f Worker shaking thrashed hay over the field-gate.
g Worker removing the thrashed hay from the gate.
h Heap of thrashed hay.
i Worker building coll as a man forks the hay.
k Barn-sheet on which a worker is riddling hay-seed.
l Heap of hay-seed.
m Sacked hay-seed.
n o Finished colls of thrashed hay.
p Ladder.
r Spare rake.
s Provisions.

One labourer raked up the ground behind, while another loosened the sheaves and pitched them to the thrashers. After thrashing the hay was shaken (f) and put on the ground (g), before being built into tramp-pikes.

Other forms of task organisation existed. Two women instead of three, might be sufficient for a threshing-floor. "We have one woman on the wind end, to supply the floor with unthrashed cocks, another strong one on the end to shake the hay and throw it well back behind her, till the tramp rickers can begin[124]. Similarly, instead of a horse, four children might be employed to carry in the hay and rake the field[125].

Tramp pikes were so called "because they are built and tramped, a manbuilding, and his assistant a field-worker, carrying the hay from the fork of the carter and tramping the rick at the same time". Another form of task organisation had the pike "pressed down by the weight of the person who built them, while another man forked the hay and a third shaped the cole"[126]. That shown in Fig.211 has only two people, one forking, one tramping.

124. Anon, "On Hay Harvest", Scots Farmer, vol. 2, p. 228.
125. ibid.
126. Keith, General View Aberdeen, p. 344.

Generally, however, it seems that three workers were required. Hence, our labour input of 3.99 man-days per acre to put one acre of hay into a tramp-pike.

While the hay was ricked, the ryegrass seed was collected from the barn sheet which lay underneath the gate acting as a threshing floor. It was then riddled and put into sacks. Carried to the barn, it might be riddled again, laid out in ridges and turned every 24 hours before being put into the fanners and riddled again[127]. We have no means of calculating labour inputs for these tasks, and simply take the labour required for the best recommended practice of three winnowings[128].

Labour productivity in threshing ryegrass depended on the threshers. Two men were allotted for every 4 acres of hay, giving a labour input of 0.50 man-days per acre[129]. The total labour input required for 4 acres is 10 people.

127. Anon, "On Hay Harvest", p. 230.
128. Stephens, Book of the Farm, 2nd edn., vol. 2, p. 242.
129. Anon, "On Hay Harvest", p. 228.

Perhaps we may subtract one of the fieldworkers (g), as superfluous. This gives a labour input of 2.5 man-days per acre. But, of course, only enough seed was required as was sufficient to sow next years crop. "A fair crop of ryegrass" is said to have yielded 26 bushels of seed for one acre(945.56kg)[130]. The seed rate for ryegrass in the Forth Valley was only one bushel per acre. Hence the labour input to supply seed for one acre is only 0.09 man-days.

Table 2.15

RYEGRASS/CLOVER: LABOUR INPUTS BY CULTIVATION ACTIVITY

CULTIVATION ACTIVITY	MANDAYS PER ACRE
Mowing	1.00
Drying	7.98
Threshing	0.09
Winnowing	0.01
Leading in	2.76
	11.84

2.2.6. Turnips.

Soil conditions determined the number of prepartory ploughings. A field might receive as many as 8, but the average was 4 or 5, once in autumn, twice in spring, and finally when the ridges were drilled in early

130. Stephens, Cyclopedia, vol. 2, p. 215.

summer. Between ploughings, the land was harrowed[131]. Any remaining weeds were then picked up by hand: we adopt the figure of 1.5 man-days per acre for one weeding[132]. The seed was always drilled: 0.16 man-days per acre[133]. After sowing the land was rolled.

Turnips required regular weeding, and both hand and horse-hoes were used in the Forth Valley. As soon as the plants reached 3 inches, they were "singled" or hand-hoed. The labour input was estimated at 3-6 man-days per Scots acre[134]. This agrees with later estimates of 4.2 - 4.8 man-days per imperial acre[135]. We adopt an average of 4.5 man-days. At six inches, the crop was horse-hoed. Two Scots acres or three English, could be done in a day[136]. We adopt the lower labour input of 0.4 man-days per acre. A second hand-hoeing followed, but this needed only half the labour of the first: 2.25 man-days per acre[137]. A second horse-hoeing preceded

131. Douglas, <u>General View Roxburgh and Selkirk</u>, pp. 91-93.
132. Morton, <u>op. cit</u>., p. 129.
133. <u>ibid</u>, p. 104.
134. Stephens, <u>Book of the Farm</u>, vol. 3, p. 756.
135. Morton, <u>op. cit</u>., p. 104.
136. Douglas, <u>op. cit</u> , p. 93; Morton, <u>op. cit</u>., p. 103.
137. Douglas, <u>ibid</u>.

"earthing up" with a double mould-board plough, which took 0.25 man-days per acre[138]. Harvesting may be subdivided into pulling, loading/carting and clamping. The first took the form of "topping and tailing" which required 2.83 man-days per acre[139]. To pull, load and cart one acre of turnips took 4 man-days[140]. Finally, clamping took 2.57 man-days per acre[141].

Table 2.16

TURNIPS: LABOUR INPUTS BY CULTIVATION ACTIVITY

CULTIVATION ACTIVITY		(1840) MANDAYS PER ACRE
Ploughing (4)		5.00
Harrowing (3)		0.48
Weeding		1.50
Drilling		0.16
Rolling		0.16
Hand-hoeing (1)		4.50
Horse-hoeing (1)		0.40
Hand-hoeing (2)		2.25
Horse-hoeing (2)		0.8
Earthing up		0.25
Harvesting:	Topping & tailing	2.83
	Loading & carting	1.17
	Clamping	2.57
		21.99

138. ibid.

139. McConnell, op. cit., p. 80.
140. Raynbird, "On Measure Work", p. 128.
141. ibid, p. 129.

2.2.7. Summer fallow

On the clay soils where turnips could not be grown, farmers substituted summer fallow. Most of the Forth Valley fell into this category, and fallow played a key role in the rotation, restoring soil fertility between grain crops. The term fallow is a misnomer, for the land was not left idle. Instead, it was worked intensively, a process both "laborious and expensive".

A total of between four and six ploughings were given at different periods throughout the year, beginning in the spring, "summer fallow is generally the first ploughed land after the winter storm", and ending in early September. Between the second, third and fourth ploughings, the land was harrowed. Weeds would have to be hand-gathered and burnt, probably not after every harrowing, but at least once. Finally, a roller was used to break the remaining clods and ensure a smooth surface for sowing[142].

142. Sinclair, Account, vol. 1, p. 234.

Table 2.17

SUMMER FALLOW: LABOUR INPUTS BY CULTIVATION ACTIVITY

CULTIVATION ACTIVITY	MANDAYS PER ACRE (1840)
Ploughing (6)	7.50
Harrowings (3)	0.96
Gathering weeds	1.50
Rolling	0.08
	10.04

2.2.8. Potatoes.

Grown universally for home consumption, potatoes were cultivated commercially only near villages and towns. Once again, soil conditions prevented their growth in the Carse[143]. The recommended practice in preparing land for potatoes was to plough before winter, and again in March, followed by several harrowings[144]. Manure was then applied before drilling. 40-50 cart-loads were given[145]. Since potatoes were sown after fallow, and were generally reckoned a scourging crop, it seems reasonable to assume heavy manuring and we adopt the same labour input as for wheat.

144. Robertson, General View Midlothian, p. 87.

143. Graham, General View Stirlingshire, p. 173.

145. 'Rusticus'. "On the Culture of Potatoes", The Scots Farmer, vol. 1,(1773), No. XLiV, p. 334.

Task organisation was complex, and is illustrated in Fig. 2.12. Here the operations have been shown simultaneously, which was not always the case. Instead, one saw "the dung carted out and spread in one yoking, and the setts planted and the dung covered in another, by the same people and horses"[146]. The first task was spreading the dung. The recommended form of task organisation calls for one man to fork the manure down from the cart, one woman to spread the heap evenly between the drills, and one woman to fill each of the three drills: a grand total of 5 people[147]. With this form of task organisation, spreading one acre required 1.25 man-days. But often 3 women spread over 5 drills instead of 3: at 30 inches between the drills, this would double labour productivity[148].

The potatoes were hand-planted in the drills in setts. These were cut from old potatoes: the amount required to plant an acre could be cut in 0.05 man-days[149].

146. Smith, General View Galloway, p. 143.

147. Stephens, Book of the Farm, vol. 2, p. 664.

148. ibid.

149. McConnell, op. cit., p.

Figure 2.12

Potato-planting.

a Ploughman making up single drills in preparation for planting.
b c Single drills on one side of feering.
b c d e Feering for single drills.
d e Single drills on other side of feering.
f Dunghill.
g Cart going with dung.
h Steward hawking out dung for 3 drills.
i Dung-heap in middle drill for 3.
k Worker dividing the dung-heap into the 3 drills.
l m n The 3 drills.
n o p 3 workers, each spreading the dung in 1 drill.
r 3 hindmost planters.
s 3 foremost planters.
t Cart of cut sets of potatoes.
u Ploughman splitting in double drills.

It took 3.00 man-days to sett an acre[150]. Total labour inputs for the form of task organisation shown in Fig.2.12 are, therefore, 8.16 (manuring), 0.05 (cutting setts), 3.00 (planting), and 0.16 (drilling), or 11.37 man-days per acre. When seedlings appeared, the crop was hand-hoed: 4.5 man-days per acre. Later, three horse-hoeings were required: 1.2 man-days. Harvesting could now begin.

Two different methods were in use in the Forth Valley. Potatoes were either ploughed up, or lifted with the graip[151]. By the second method, a man was estimated to dig between 0.20-0.33 acres per day[152]. He provided enough work for two gatherers[153]. Hence three people in one day could harvest 0.25 acres, giving a labour input of 12 man-days per acre. Productivity was higher harvesting with the plough, but task organisation required at least 6 and usually 8 gatherers[154].

150. Stephens, Cyclopedia of Agriculture, vol. 2, p. 182.

151. Graham, op. cit., p. 177.

152. Stephens, Book of the Farm, vol. 3, p. 1125; McConnell, op. cit., p. 80.

153. Anon, "On the cultivation of potatoes", Farmers Magazine, vol. 8, (1807), No. XXX1, p. 296.

154. 'Rusticus', "Culture of Potatoes", p. 335.

Eight women gatherers would clear one acre in 8 hours[155]. With the labour of the ploughman, this meant a labour input of 7.40 man-days per acre.

After lifting, potatoes were thrown onto carts and carried to clamps for storage throughout the winter. Eight gatherers could put the produce of an acre into carts in 2 hours, giving a labour input of 1.6 man-days per acre[156]. We adopt the same figure for clamping as for turnips: 2.57 man-days.

Table 2.18

POTATOES: LABOUR INPUTS BY CULTIVATION ACTIVITY

CULTIVATION ACTIVITY	MANDAYS PER ACRE(1840)
Ploughing (2)	2.5
Harrowing (3)	0.96
Manuring	8.16
Drilling	0.16
Cutting setts	0.05
Planting	3.00
Hand-hoeing	4.50
Horse-hoeing (3)	1.20
Harvesting: Plough	7.40
Graip	12.00
Loading and carting	1.60
Clamping	2.57
	36.70

155. Anon, "On potatoes, Ploughing matches &c", Farmers Magazine, vol. 9, (1808), No. XXXV1, p. 446.

156. ibid.

2.2.9. Flax.

Flax was highly labour intensive, and could be grown virtually anywhere, though yields were highest on "haughs", or alluvial loams. As a field crop, it was usually sown after oats. The stubble was ploughed under immedately after harvest. The land was ploughed again after winter in late January or early February, then harrowed[157]. Before sowing, the ground had to be flat, so the roller was used[158]. Seed was broadcast.

Women weeded the plant when it was 5-6 inches high. One estimate found "by Experience, that eight Persons, in two Days, have weeded an Acre of old Lim'd Ground when in Lint"[159]. This gives a labour input of 12.59 man-days per acre. By July, the crop was ready for harvesting. Flax was "pulled", then bound and sto oked

157. William Aiton, "On the Cultivation of Flax in Holland and in Scotland", Quarterly Journal of Agriculture, vol. 4, (1832-43), No. XVII, pp. 164-168.

158. James Macadam, "On the Cultivation of Flax", Journal of the Royal Agricultural Society of England, vol. 8, (1847), No. XIV, p. 370.

159. (Richard Bradley), A Treatise Concerning the Manner of Fallowing of Ground, Raising of Grass-Seeds and Training of Lint and Hemp, for the Increase and Improvement of the Linen-manufactories in Scotland., etc., (Edinburgh, 1724), p. 62.

like ordinary corn. The recommended practice was to stook fine, middling and coarse flax separately. We are told that "Two binders and ten pullers should pull and stook an acre in ten hours", giving an input of 12.00 man-days per acre[160]. Another estimate is much lower: 21 man-days to pull and 11 man-days to stook 5 acres, giving an input of 6.4 man-days per acre[161]. The average is 9.2 man-days. When fully dry, the flax was carted to the barn for rippling.

Two methods were employed. Sometimes the sheaves were untied and the flax spread on the floor to be beaten with mallets[162]. Alternatively, the flax was "rippled" with steel combs, as follows: "Two men sit upon the bench, one at each end, facing each other, alternately drawing handfuls of flax, (brought to them by women, whose business is to untie the sheaves as carefully as possible), spread out like a fan, briskly through the rippling comb once or twice, as may be necessary. The bench is placed on a barncloth, to catch the bolls as they are stripped off, and the straw is again carefully tied into bundles or "breaks" and carried away"[163].

160. Anon, "On the Cultivation of Flax", Transactions of the Highland Society of Scotland, Ns(1851-53), p. 318.
161. ibid, p. 326.
162. (Bradley), Treatise, p. 65.
163. Anon, "Cultivation of Flax", pp. 319-320.

Two estimates of output are available: 12-18 cwt in 10 hours by 2 men (or 304.81kg-457.22kg per man-day); or "when practised, four men, with two rippling combs, will take the seed off rather more than an acre in the day"[164]. Now, yields of flax varied widely, between 20-40 stone per acre. We take 30 stone as the average (190.50kg)[165]. An acre of flax could thus be rippled in 2 man-days.

The fibre had then to be steeped in water, usually in the nearest pond. Labour was required for carting. We know that it took 6 man-days to cart the product of 2.6 acres of flax fifteen miles and steep it, giving 2.30 man-days per acre[166]. After 5-10 days "retting" the fibre was removed. "A person should stand in the water, lifting out the bundles to the bank, and in no case should he use a pitchfork or hook; others on the bank secure the bundles and set them up on their but ends" to dry[167]. In Scotland, the flax was "gaited", like corn, each sheaf being stood by itself with the root end on the ground, spread fanwise[168]. Later, the fibre was grassed or spread on the meadow and turned twice[169]. Taking out and spreading

164. ibid, p. 320; Macadam, "Cultivation of Flax", p. 375.
165. Durie, Linen Industry, p. 74, Average yield, 31.75 stones per acre.
166. Anon, "Cultivation of Flax", p. 328.
167. Macadam, op. cit., p. 381.
168. Aiton, op. cit., p. 177.
169. Macadam, op. cit., p. 381.

was estimated to take 5.0 man-days per acre[170]. The dried flax was then put into small ricks and stacked: this took another 4.24 man-days[171].

Separating the fibre from the wood, or "scutching", now began. If this were done manually, the flax was first bruised with a hand-mallet over a smooth stone[172]. We have no information on the labour required, but we do have estimates for scutching. "An expert scutcher can turn out from 81 lbs. to 14 lbs. (3.62-6.35kg) in a day, but the quantity will depend on the quality: as, of hard, coarse, badly watered flax, not more than one half or one third this quantity, could be done in the same time"[173]. Likely as not, the flax produced in the Forth Valley, as elsewhere in Scotland, was of poor quality and would have taken twice as long to scutch. We adopt a coefficient of 2.49 kg per man-day. Now the average weight of the crop after steeping and drying was 32.88% of that when pulled[174]. With an average yield of 190.50 kg., only 62.63 kg will need scrutching. This will occupy 25.15 man-days.

170. Anon, "Cultivation of Flax", p. 322.
171. Aiton, op. cit., p. 77.
172. ibid, p. 80.
173. Macadam, op. cit., p. 383.
174. ibid, p. 390, Table

Before spinning, the fibre had to be "heckled" or combed. Heckling separated the lint from the tow, or coarsest fibre. Unfortunately, we have no data on the labour inputs. But task organisation involved drawing the flax three or four times through the heckle, ("which is compposed of three or four dozen of fine steel teeth"), and may well have been more labourintensive than scutching (25 man-days)[175]. An acre of flax produced 340 lbs. of yard of varying qualities. All was used. If 340 lbs. of yard produce 38 lea of 800 yards each (30400 yards)[176], and we know that "a woman, who is a tolerable hand at the spinning wheel, will spin 10 hiers, or 20 cuts per day"[177], then 50.66 man-days are required to spin the produce of one acre of flax. Such high labour inputs for cultivation and manufacturing based on a simple technology made flax a peasant crop _par excellence_.

175. James Dickson, _A Series of Letters on the Improved Mode in the Cultivation and Management of Flax_, (London, 1846), pp. 196-197.

176. Anon, "Extract of a letter from a Linen manufacturer to Sir John Sinclair", _Farmers Magazine_, vol. 1, (1800), No. 3, p. 262.

177. James Mill, "On the Spinning of Linen Yarn, in Ross, Cathness, &c", _Prize Essays and Transactions of the Highland Society ofScotland_, vol. 1, (1799), p. 72.

They did so because of the low opportunity-cost for labour characteristic of a peasant economy: as Kames remarked, "stating every article by a just calcul, lint purchased at a market would come cheaper to them than what they thus procure"[178].

Table 2.19

FLAX: LABOUR INPUTS BY CULTIVATION ACTIVITY

CULTIVATION ACTIVITY	MANDAYS PER ACRE
Ploughing (2)	2.5
Harrowing (2)	0.64
Weeds gathered	1.50
Sowing	0.06
Weeding	12.59
Pulling	9.20
Binding and stooking	na
Rippling	2.00
Retting	2.30
Grassing	5.00
Stacking	4.24
Scutching	25.15
Heckling	25.00
Spinning	50.66
	140.84

178. Lord Kames, Progress of Flax Husbandry, (Edinburgh, 1766), p. 18.

2.2.10. Aus.

The field was ploughed twice after the harvest of the preceding crop. Seven to eight ploughings then pulverised the soil, and the remaining clods were broken by two harrowings. Another ploughing and harrowing came a week before sowing. On the day the *aus* was sown, the land was given a further preparatory ploughing and laddering. Afterwards, the seed was ploughed under and rolled once. A harrowing was given when the crop reached 9 inches. One to three weedings were necessary. When tillering began, the field was watered and a *langla* or small plough passed over it. When no water was available the field was turned up by the spade or *kodali*[179].

Table 2.20

AUS: LABOUR INPUTS BY CULTIVATION ACTIVITY

CULTIVATION ACTIVITY	MANDAYS PER ACRE
Ploughing (11.5)	34.5
Laddering (4)	4.33
Sowing	3.00
Rolling	0.33
Harrowing	0.33
Weeding (2)	25.00
Ploughing	3.00
Harvesting	21.00
Threshing	6.00
Winnowing	9.00
	109.48

179. Sen, *Report on Burdwan*, p. 17-18.

2.2.11. Aman: transplanted.

The nursery was ploughed 4-5 times, and the lepichanga passed over it several times[180]. The nursery was then sown. Next, the embankments or ails surrounding the field were repaired. The field received 2.3 ploughings, and one laddering before transplanting[181]. Two or three weedings were given before harvest[182]. Irrigation was sometimes required in Burdwan.

Table 2.21

AMAN: LABOUR INPUTS BY CULTIVATION ACTIVITY

CULTIVATION ACTIVITY	LABOUR INPUTS PER ACRE
Nursery ploughing (4.5)	13.5
Lepichanga (2)	0.66
Nursery Sowing	0.37
Repairing ails	5.90
Ploughing (2.5)	7.5
Laddering	0.33
Transplanting	13.00
Weeding (2.5)	31.25
Irrigation	9.00
Harvesting	21.00
Threshing	3.00
Winnowing	9.00
	114.51

180. Sen, Report on Dacca, p. 30.

181. Sen, Report on Burdwan, p. 21

182. ibid.

2.2.12. Aman: broadcast.

The straw from the previous harvest was burned and the field ploughed once or twice. One or more ploughings were given before the clods were broken. Sowing was preceded by one or two ploughings and harrowings. The seeds were ploughed under. After germination, the land was rolled twice with the ladder. A raking followed to thin the crop. Weeding might be as much as three times over or might not be given at all[183].

Table 2.22

B AMAN: LABOUR INPUTS BY CULTIVATION ACTIVITY

CULTIVATION ACTIVITY	MANDAYS PER ACRE
Ploughing (3.5)	13.5
Harrowing (1.5)	0.49
Sowing	3.00
Ploughing	3.00
Laddering (2.0)	0.66
Raking	0.33
Weeding	18.75
Harvesting	21.00
Thrashing	3.00
Winnowing	9.00
	69.73

183. Sen, Report on Dacca, p. 29; Sen, Report on Burdwan, p. 20.

2.2.13. Boro.

The nursery land was ploughed 3-5 times and puddled by passing the lepichanga over it 2-3 times. The nursery was then sown. No ploughing was usually necessary on the soft alluvial left by the receding flood. Where the land was stiffer, 3-5 ploughings might be required. After transplanting, irrigation was given by the duni (Dacca) or donga (Burdwan)[184].

Table 2.23

BORO: LABOUR INPUTS BY CULTIVATION ACTIVITY

CULTIVATION ACTIVITY	MANDAYS PER ACRE
Ploughing (4)	10.5
Lepichanga (2)	0.66
Nursery sowing	0.37
Ploughing (2.5)	7.5
Transplanting	13.00
Irrigation	12.00
Harvesting	21.00
Threshing	3.00
Winnowing	9.00
	77.03

184. Sen, Report on Dacca, p. 32.

2.2.14. Oilseeds.

Mustard, the most common oilseed, was sown after aus or jute. Eight ploughings were necessary on average, with eight harrowings. Sowing was followed by ploughing and harrowing[185]. The breakdown for the remaining labour inputs is taken from the practices in Birbhum district, western Bengal[186].

Table 2.24

OILSEEDS: LABOUR INPUTS BY CULTIVATION ACTIVITY

CULTIVATION ACTIVITY	LABOUR INPUTS PER ACRE
Ploughing (8)	24.00
Harrowing (8)	2.64
Sowing	3.00
Ploughing	3.00
Harrowing	0.33
Irrigation	9.00
Reaping	6.00
Detaching seed	6.00
	53.97

185. ibid, p. 53.

186. Report on Beerbhum, p. 49.

2.2.15. Pulses.

Pulses like khesari were always sown as catch-crops after rice. With aus, the land needed between 1-5 ploughings, but no ploughings were necessesary with aman[187]. The breakdown of labour inputs is again taken from Birbhum district in western Bengal.

Table 2.25

PULSES: LABOUR INPUTS BY CULTIVATION ACTIVITY

CULTIVATION ACTIVITY	LABOUR INPUTS PER ACRE
Ploughing (3)	9.00
Manuring	6.00
Sowing	3.00
Irrigation	9.00
Reaping	3.00
Detaching grain	3.00
	33.00

187. Sen, Report on Dacca, p. 48.

2.2.16. Jute, sugar, tobacco, wheat.

The labour inputs and cultivation activities for the three major commercial crops and wheat, all derive from modern data from Bangladesh[188]. All inputs quoted refer to the cultivation practices for traditional varieties, (TV's).

Table 2.26

JUTE: LABOUR INPUTS BY CULTIVATION ACTIVITY

CULTIVATION ACTIVITY	LABOUR INPTS PER ACRE
Land preparation	3.06
Ploughing	24.80
Sowing	1.6
Manuring	4.46
First weeding	49.13
Mulching	0.56
Other weedings	0.6
Plant protection	0.02
Cutting/retting	26.13
Stripping/washing/ drying	29.86
	139.73

188. Costs and Returns Survey for Bangladesh, 1978-79 Crops, (Dacca, 1979), vol. VII, Jute, p. 39. (Average Totals): Jabbar and Farukh, "Labour Requirements", pp. 110-113; Tables 4, 7, 8. (Jarti tobacco, maincrop sugarcane).

Table 2.27

SUGAR: LABOUR INPUTS BY CULTIVATION ACTIVITY

CULTIVATION ACTIVITY	LABOUR INPUTS PER ACRE
Preparing land, manuring	2.80
Preparing set	10.13
Trench making, planting	24.26
Weeding, mulching	54.13
Gap filling	-
Topdressing, tying, trashing	18.26
Spraying	-
Harvesting, marketing	40.13
	174.93

Table 2.28

TOBACCO: LABOUR INPUTS BY CULTIVATION ACTIVITY

CULTIVATION ACTIVITY	LABOUR INPUTS PER ACRE
Preparing land	46.66
Transplanting	12.80
Weeding	47.73
Irrigation	53.06
Manuring	17.86
Harvesting, drying	58.13
	236.26

Table 2.29

WHEAT: LABOUR INPUTS BY CULTIVATION ACTIVITY

CULTIVATION ACTIVITY	LABOUR INPUTS PER ACRE
Preparing land	13.86
Manuring, sowing, fertilising	2.53
Weeding, spraying, irrigation	6.26
Harvesting, carrying	9.33
Threshing	4.26
Winnowing, storing	2.66
	38.93

Table 2.30

LABOUR INPUTS IN BENGAL AND THE FORTH VALLEY

SUBSISTENCE CROPS

FORTH VALLEY	MANDAYS	BENGAL	MANDAYS
Wheat	35.72	Wheat	38.93
Barley	33.63	*aus*	109.48
Oats	18.73	b.*aman*	69.73
Peas/beans	21.48	t.*aman*	117.50
Clover/ryegrass	14.80	*boro*	77.03
Turnips	27.48	pulses	36.00
Potatoes	45.87	oilseeds	53.97

COMMERCIAL CROPS

FORTH VALLEY	MANDAYS	BENGAL	MANDAYS
flax	140.84	jute	139.73
Summer fallow	10.04	sugarcane	174.93
		tobacco	236.26

Source: See text.

Note: Labour inputs expressed in mandays of 10 hours (Forth Valley), and 6 hours (Bengal).

Section 3.

Obviously, a large margin of error surrounds these estimates of labour inputs (Table 2.30). This is inevitable given the poverty of the historical evidence. Some check on the accuracy of the labour inputs for Bengal is provided by comparable estimates for modern Bangladesh. The Bangladesh Costs and Returns Survey for 1978-79 supercedes all previous efforts to quantify labour inputs for the region[189]. Even these results are not wholly accurate. For example, the published labour input of 49.7 mandays per acre for broadcast *aman* omitted to include weeding during the early stages of plant grwoth. The real total is 104.00 mandays per acre[190]. Nevertheless, the Survey remains the best available. A comparison with our own estimates for 1890 suggests that labour inputs in the 19th century were well below contemporary levels, perhaps by as much as 70%.

189. Much forward planning in Bangladesh rests on earlier defective estimates from the USAID Survey. Eg., Edward J. Clay and Md. Sekundar Khan, *Agricultural Employment and under-Employment in Bangladesh: The Next Decade.* BARC Agricultural Economics and Rural Science Papers, No. 4, (Dacca, Oct.. 1977).

190. I am grateful to Mahmood Khan of the Dept. of Economics, Dacca University, who worked with the 1978-79 Survey, for this information.

Table 2.31

BENGAL LABOUR INPUTS 1890-1980

(Mandays)

CROP	1890	1980	%
Aus	82.11	103.86	+26.48
b *aman*	52.29	104.00	+98.89
t *aman*	88.12	133.86	+51.90
boro	57.77	109.33	+89.25
Average increase			+66.63

Source: *Costs and Returns Survey for Bangladesh 1978-79 Crops*. Agro-Economic Research Section, Ministry of Agriculture and Forests (Dacca, Bangladesh, 1979), vol. 1, 2,3,5.

Note: All labour inputs expressed in standard mandays of eight hours.

It might be argued that this wide disparity casts doubt on our own estimates and that in the absence of reliable historical evidence on labour inputs, the modern data provides an acceptable substitute. After all, the tools have not changed. The only important labour-saving innovation in Bengal agriculture during the 19th century was the introduction of the iron sugar mill. Its inventors claim that the Behea sugar mill led to a 50-100% reduction in labour costs is probably an exaggeration, but the new mills certainly improved labour productivity[191]. Wooden mills were both harder for bullocks to pull and crushed the cane less efficiently[192]. With the exception of sugar processing, however, tools remained the same. A modern case study of a village in Mymensingh notes that "The agricultural implements reported by Hunter as being in use in this area in 1870 are exactly the same as those currently in use"[193].

Yet it is a mistake to assume that labour inputs to subsistence crops remain constant. So long as the marginal productivity of labour is positive, labour inputs to agriculture may increase. Given the extent of population pressure on land in Bangladesh, (the most densely populated country in the world), it would indeed be surprising to find no change in labour inputs. Given a static

191. Bengal Financial Proceedings, vol. March 1884. Colln. 10-11, Commr. Patna Division - Secy. Govt., Bengal Finance Dept., 10 March, 1883; para. 25.

192. Sen, Report on Burdwan, p. 26. The labour coefficient for crushing cane with a Behea mill was 7.5 mandays per acre. (Carstairs, op. cit., p. 32). Assuming iron mills doubled labour productivity, this represents a reduction of only 4% in total labour input.

193. Mead T. Cain, "The Economic Activities of Children in a village in Bangladesh", Population and Development Review, vol. 3, No. 3, (Sept. 1977), p. 226, note 9.

technology, the only way to have fed a growing population would have been for farmers to have squeezed more from the same resources. More intensive ploughing or weeding might have become necessary to ensure greater yields or even to keep yields from falling. Hence, one might expect to find higher labour inputs to the major rice crops.

It is instructive to contrast these figures of labour inputs with the comments of 18th century British obervers on Bengal agriculture. One wrote,

> "We, in Britain, who are convenant with the immense labour required to extract one crop in the year from the soil, cannot but wonder how, with so few hands, the Indian farmer can accomplish so much. But it must be remembered that in the East, nature is the great agriculturalist. The Indian labourer does but little work, and that little badly. An English or Scotch farm servant, supposing he would work in a tropical temperature, would be worth the services of three Indian coolies"[194].

In fact, labour inputs to Bengal agriculture were far higher than in the Forth Valley. The major rice crop aman, required about 70 standard mandays per acre, or over

194. Anon, "The Bengal Ryot", Blackwoods Magazine, vol. 113, (Feb. 1873), p. 156.

three times the labour input for the staple Scottish cereal oats. The least labour intensive cereal in Bengal was wheat, which was the Forth Valley's most labour intensive food grain. Even the new fodder crop, turnips, which played a key role in raising land productivity on light soils was less labour-intensive than any of the subsistence crops grown in Bengal. Transplanted aman, the most labour-intensive rice crop of all, was over six times the labour input needed for oats. Claims that "It might be said almost literally of a ryot in a rice district, that he has "but to cast his corn upon the waters, and he find it again after many days" were based not on observation but ignorance[195].

This disparity between Bengal and the Forth Valley widened over time as new technology introduced during the agricultural revolution raised labour productivity. Four major labour-saving innovations were identified in section 1.

The first was ploughing. The old Scots plough required 2.5 mandays per acre, whereas Small's two-horse plough requir d only 1 man-day. The second innovation was harvesting. The smooth sickle replaced the serrated sickle to be replaced in turn by the scythe. The smooth sickle

195. Anon, "The Bengal Ryot", Blackwoods Magazine, vol. 113, (Feb. 1873), p. 156.

improved labour productivity by 25%. The scythe improved on the smooth sickle by about 30%, after allowing for changes in task organisation. The overall change is shown in the Table below.

Table 2.32

HARVEST LABOUR INPUTS 1760-1840
(mandays per acre)

Serrated sickle	3.1	-
Smooth sickle	2.35	+24.27%
Scythe	1.75	+77.14%

Source: Table 2.2.

Machine thrashing, the third innovation, replaced the flail. Output from two-horse-power thrashing machines, the size normally found in the Forth Valley, was estimated at 42.89 hl. per day. Six people were required from its operation, giving an output of 7.15 hl. per man-day. The rise in labour productivity over the flail is shown in Table 2.33 below.

Table 2.33

THRASHING LABOUR INPUTS, 1760-1840
(hectolitres/manday)

CROP	FLAIL	MACHINE	% INCREASE
Oats	4.36	7.15	+63.99
Barley	3.63	7.15	+96.96
Wheat	2.90	7.15	+146.55

Source: Section 2.1.4.

Fourth, and finally, machine fanners replaced manual winnowing. Output for fanning and measuring was estimated at 16.0 hl. per manday. Output winnowing by hand was 1.8 man-days per acre, in addition to labour required for measuring. Output measuring was estimated at 13.09 hl. per man-day. The productivity increase for each farm crop is set out in the Table below.

Table 2.34

WINNOWING, FANNING, MEASURING LABOUR INPUTS
(hectolitres per man-day)

CROP	WINNOWING	FANNING	%INCREASE
Carse wheat	2.61	0.66	+295.45
Carse barley	2.72	0.75	+262.66
Carse oats	2.71	0.74	+266.21
Dryfield barl.	2.58	0.64	+303.12
Dryfield oats	2.57	0.63	+307.93

Source: Section 2.1.4.

Labour inputs for all farm crops were then adjusted to allow for changes in land productivity. Information on yields per acre in 1840 was derived from the Statistical Accounts, while yields in 1760 were taken from contemporary estimates. The change in land productivity is shown in the Table below.

Table 2.35

YIELDS IN THE FORTH VALLEY 1760-1840
(hectolitres per acre)

CROP	1760	1840
Carse oats	7.07	11.94
Dryfield oats	7.01	10.14
Carse barley	7.07	12.06
Dryfield barley	7.07	10.25
Peas and beans	9.12	10.00

Source: OSA, vols. lX, Xll, NSA, vol. 8.

We can now proceed to measure the rise in labour productivity following the adoption of all four innovations. Their introduction was not simultaneous, but spread over a period of 80 years. In 1760, the four-horse plough, the flail, the serrated sickle, and winnowing were all common farm practices. By the 1790's, the two-horse plough, the smooth sickle and machine fanners were in everyday use. By the 1840's, the cycle of innovation was complete, with adoption of the scythe. The cumulative rise in labour productivity is shown in the Table below.

Table 2.36

INCREASE IN LABOUR PRODUCTIVITY. FORTH VALLEY 1760-1840
(man-days per acre)

DATE	C. BAR.	C. OATS	P&B	D. BAR.	D. OATS
1760	33.63	17.98	21.43	32.99	17.98
1790	22.99	13.16	15.04	22.63	12.80
1840	22.42	12.59	14.44	22.06	12.23
+%	50.00%	42.81%	48.40%	49.54%	47.01%

Source: See Appendix D.

Differences in labour inputs tell us nothing about labour productivity. These differences may be explained in several ways, for example, factor indowment when land is the scarce factor of produciton and labour is cheap, it is more efficient to employ more labour in production. Conversely, where land is abundant and labour scarce, it is more profitable to use less labour in production. Hence labour productivity in the west today is much higher than in India, but where land is abundant, as in America, the productivity of land is about the same[196]. Hence, higher labour inputs in Bengal may simply reflect the greater availability of labour. In order to compare labour productivity, we need data on output.

196. Paul Bairoch, "Agriculture and the Industrial Revolution, 1700-1914", in Carlo M. Cipolla, ed., The Fontana Economic History of Europe, (Glasgow, 1980), vol. 3, p. 461.

Figures 2.14, 15 compare labour productivity in Bengal and the Forth Valley by using our estimates of labour inputs with the data on land productivity presented in Chapter 1, Section 1. The difference in labour inputs is seen to reflect a significant difference in labour productivity. Despite higher labour inputs, productivity in Bengal was lower than in the Forth Valley.

Table 2.37

OUTPUT PER MAN-DAY, BENGAL AND THE FORTH VALLEY
(hectolites/man-day)

	FORTH VALLEY		BENGAL		
CROP	1760	1840	CROP	1870	1914
Oats	0.39	0.94	Aus	0.08	0.05
Barley	0.21	0.53	Aman	0.14	0.09
Wheat	-	0.29	Boro	0.12	0.08

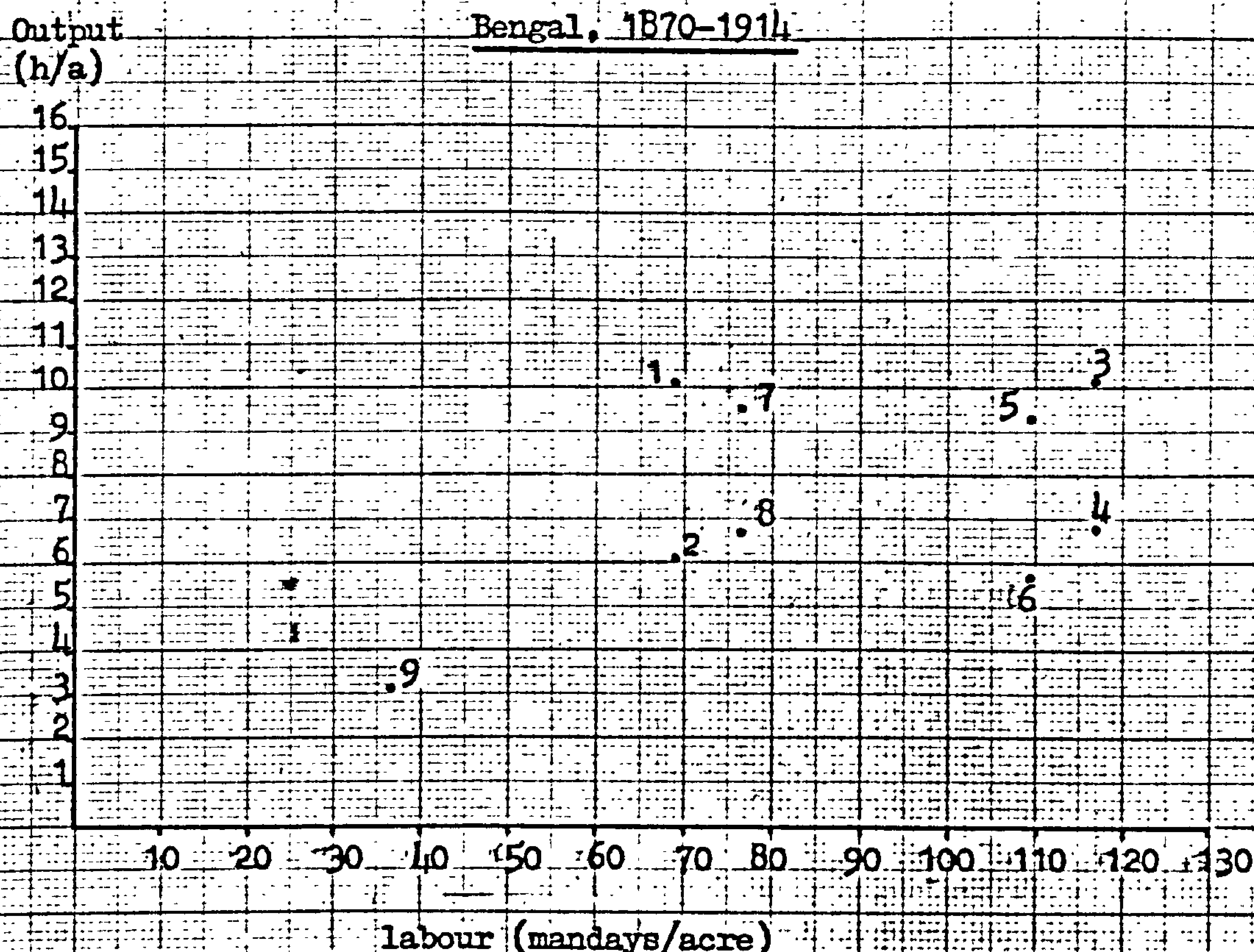
Source: Chapter 1, Tables

This was apparently the case even before the agricultural revolution. Paul Bairoch has reached a different conclusion:

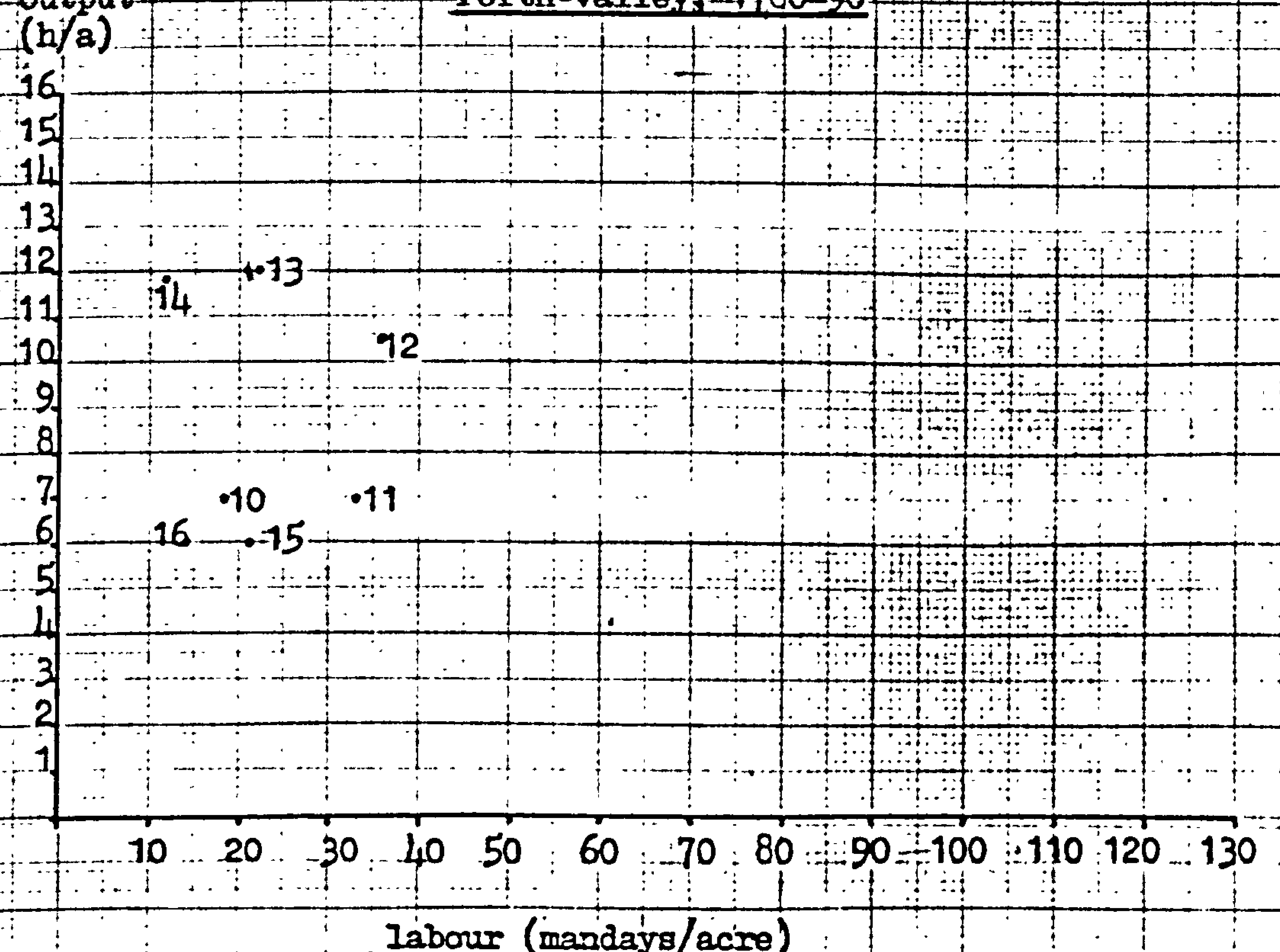
Figure 2.13

Labour productivity in two traditional agricultures

Bengal, 1870-1914



Forth Valley, 1760-90



1	b. aman	1870	7	boro	1870	10	oats	1760
2	b. aman	1914	8	boro	1914	11	barley	1760
3	t. aman	1870	9	pulses		12	wheat	1790
4	t. aman	1914				13	barley	1780
5	aus	1870				14	oats	1790
6	aus	1914				15	peas/beans	1760
						16	peas/beans	1790

> "The present average level of agricultural productivity in African and Asian countries is 45 per cent below that reached by the developed counties at the start of the industrial revolution. In fact, it is at the same level as that of the European countries before their agricultural revolution"[198].

198. cf. Paul Bairoch, The Economic Development of the Third World since 1900. (London, 1975), p. 42.

Conclusion

Labour productivity in Bengal and the Forth Valley was compared by measuring the labour inputs to the major food and commercial crops. This was done by establishing the labour coefficients for the major farming tasks and then using average cultivation practices to reach an estimate of the labour required per acre for each crop. The results suggest that, contrary to what many contemporaries believed, labour inputs to agriculture in Bengal were much higher than in the Forth Valley. Moreover, a comparison of labour productivity (output per man-day), suggested that labour productivity in Bengal was lower than in the Forth Valley, both before and after the agricultural revolution. Compared to the Forth Valley in 1760, therefore, Bengal agriculture in 1870 was characterised by higher land productivity, but lower labour productivity. However, this relatively inefficient use of labour was not necessarily inefficient either in economic terms or in terms of labour utilisation. In order to determine the efficiency of labour use, we must compare the productivity of the total labour force.

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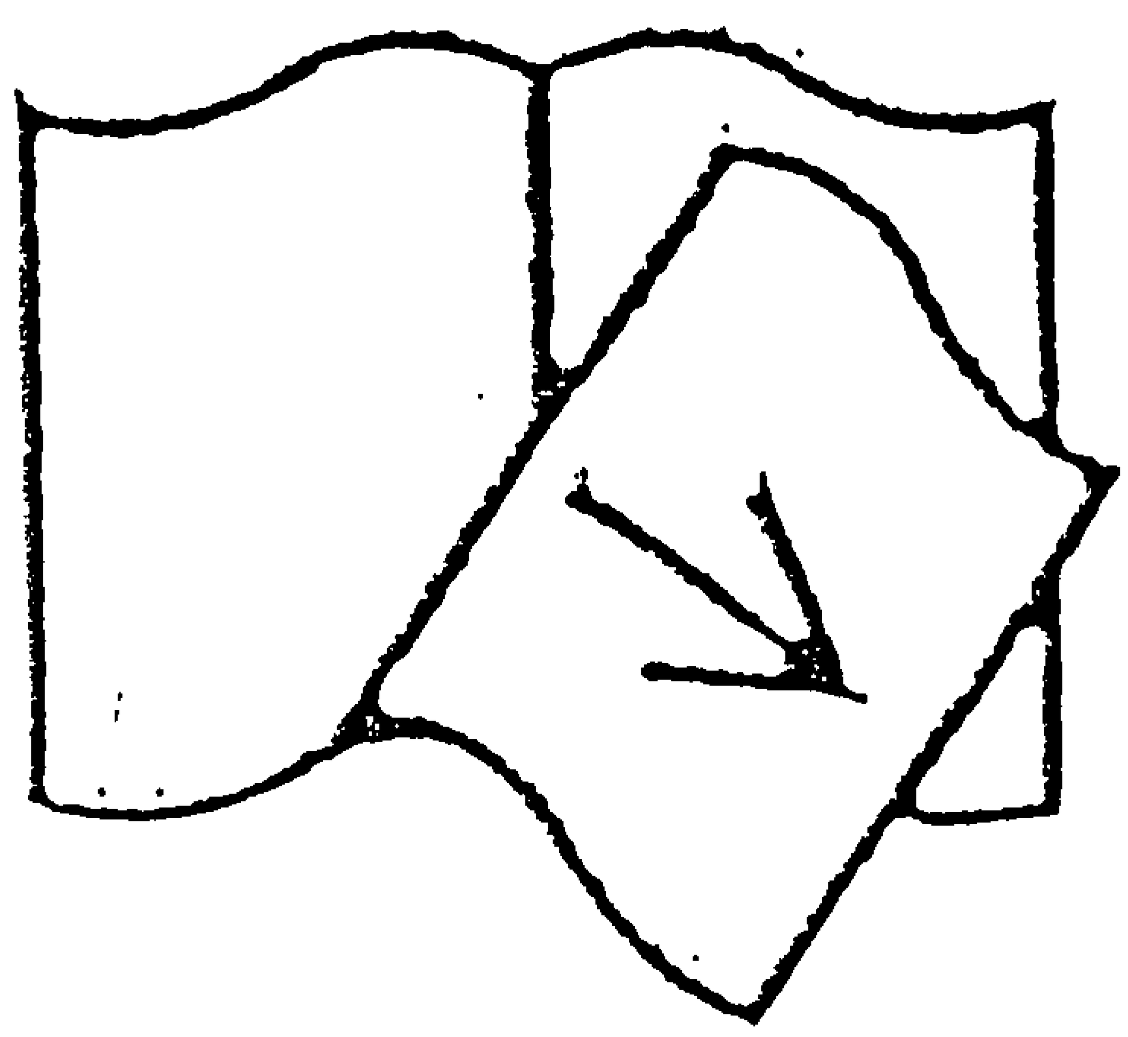


Chapter Three

Surplus Labour

This chapter compares the relationship between technology and labour supply. The nature of this relationship in traditional agriculture is controversial. Traditional agriculture's distinctive feature is low productivity and where rural populations are large, low labour productivity. This was immediately obvious to British agricultural experts visiting India before 1914:

> "In no agricultural country that I know of are so many people to be seen stalking idly about during the hours of labour as in India. The streets and court-houses and yards are full of idlers; the roads are never empty, and railway stations and natives railway carriages are crammed with people. Entering a village at any hour of the day you are surrounded by idlers. Much of this arises from the absence of other occupation than agriculture..."[1].

If labour productivity is so low that a significant proportion of the labour force may be removed from the agricultural sector without any fall in output and without any change in technology, this labour may be described as "surplus", since it contributes nothing to production.

1. James Caird, Report on the condition of India, Parliamentary Papers, vol. LIII (1880), pp. 8-9.

The measurement of surplus labour poses formidable problems of concept and method, yet the issue is too important to ignore. The existence of surplus labour casts doubt on the economic efficiency of traditional agriculture. Moreover, it has important implications for economic growth. Given an unlimited supply of labour at a fixed real wage, profits in the capitalist sector of the economy will be high, and this will encourage capital formation and further growth. The magnitude of surplus labour in the agricultural sector is thus an indicator of the potential for rapid growth in the manufacturing sector.

Our attempt to measure surplus labour in Bengal and the Forth Valley is divided into three sections. In the first section, we formulate definitions of surplus labour which are appropriate for each study area. The second section calculates the seasonal distribution of labour inputs according to the cropping calendars of both regions. Finally, the third section tests the surplus labour hypothesis by comparing aggregate labour inputs with the available labour supply.

Section I.

Surplus labour has been defined as that proportion of the agricultural labour force which could be removed from production without affecting output, assuming that no other changes occur[2]. Although this element of the labour force contributes nothing to output, however, this does not necessarily mean its marginal productivity is zero. There are several reasons for this. If real wages are already at subsistence level when the marginal productivity of labour is still positive, lowering the wage still further will reduce labour's potential for work by impairing efficiency[3]. Again, traditions of paternalism and work-sharing in peasant societies generally ensure that visible unemployment is rare. Even if it were not, it would still be extremely difficult to measure, since most of the agricultural labour force is self-employed. For these and other reasons, most of the agricultural labour force in traditional agriculture is employed, but at well below its full potential. The length of the working day may even by deliberately curtailed in order that everyone may work. In these conditions, unemployment is said to be "disguised". This term

2. CHC Kao, K.R. Anschel and C.K. Eicher, "Disguised unemployment in Agriculture: a Survey", in C.K.Eicher and L.W.Witt, Agriculture in Economic Development (New York, 1964), pp. 129-144. For Indian literature on surplus labour, see A.K.Sen, Employment, Technology, and Development (London, 1975) pp. 31-40 and P.Sanghvi, Surplus Manpower in Agriculture and Economic Development (Bombay, 1969).

3. Harvey Leibenstein, "The theory of underemployment in backward economies", Journal of Political Economy, vol. 65, (April 1957), pp. 91-103.

was originally coined to describe skilled workers forced by unemployment into unskilled labour. In this context, however, it is synonomous with a labour force working below capacity, or under-employment.

Measurements of underemployment are of two kinds. The direct method based on a sample survey, though more precise, is impossible for the historian. Here we shall use the indirect method based on secondary data. There are several possible criteria for measuring underemployment depending on the purpose of the study. We are concerned to measure the proportion of the labour force which may be removed without reducing output. Our criterion is, therefore, one of productivity. The indirect method of measuring productivity is to compare the labour input required for a given output with the labour supply. Provided our aggregates of labour input and labour supply are sufficiently accurate, the difference between the two will provide an estimate of surplus labour.

Naturally, the labour supply is not easy to measure with the necessary precision. The agricultural <u>labour force</u> may be defined as the proportion of working age engaged either fully or part-time in agriculture. The age limits for this group must be determined by assumptions which are realistic and reflect social customs.

Bengali children were employed in agriculture from an early age. "The boys become cowherds at the age of six or seven years, labourers at twelve years, and ploughmen at sixteen years"[4]. Such early socialisation was aided by the nature of traditional technology. Ploughs were "so very light that a boy, ten or twelve years of age, can work one with ease"[5]. We shall define the active agricultural population as those aged between 10-40[6]. Children cannot work so hard as adults, however. The boundary between child and adult labour in Bengal was approximately age 14. "When they reach the age of fourteen, they take their place as a man in the whole of the agricultural round"[7]. We shall define the age-group 10-15 as child-labour. Following contemporary practive, this was converted into adult-equivalents using the ratio 2:1[8].

4. Gopal Chunder Dass, Report on the Statistics of Rungpore, p. 76.

5. Robert B. Smart, Geographical and Statistical report on the District of Tipperah, (Calcutta, 1866)), p. 10.

6. Icbal Ahmed, "Unemployment and underemployment in Bangladesh Agriculture", World Development, vol. 6, (11/12) (1977), p. 1288.

7. J. C. Jack, The Economic Life of a Bengal District, (Oxford, 1916), p. 50.

8. Ahmed, op. cit., p. 1288,. See also Mead T. Cain, "The Economic Activities of Children in a village in Bangladesh", Population and Development Review, vol. 3, No. 3. (Sept. 1977), pp. 201-228.

The available labour supply is in turn determined by two other factors. The first is the participation rate. This is defined as "that portion of the labour force normally performing some work, at least when the whole year is taken into account"[9]. Institutional factors are primary here. The most important is the institution of purdah (veil) which places a high social value on secluding women from public view. As a result,

> "...the market for a woman's labour is usually demarcated both physically and functionally. The physical limits of the market for a particular woman's labour are described by a circle with a radius of 200-400 meters, with her homestead as the centre of the circle. The radius of the circle varies depending on the size of the village neighbourhood (para) in which she lives, the homogeneity of her para in terms of kinship and other social criteria, and the degree of her or her husband's social integration with the para"[10].

Female participation in agricultural labour in Bengal was, therefore, minimal. "Ryot's wives will on no account come out to the fields in which their husband's work, the breakfast being brought there by some infant girl or old female, usually the mother. As a rule, the females do not work in the fields, except the very old and the very young, who are sometimes deputed to tend cattle in plots adjoining to the homesteads"[11]. Although women from poor families

9. Gunnar Myrdal, Asian Drama. An Enquiry into the Poverty of Nations, (London 1968), vol. 2, p. 1013.

10. Mean T. Cain, "Class, Patriarchyand Women's Work, in Bangladesh", Population and Development Review, vol. 5, no. 3, (Sept. 1979), p. 428.

11. Sen, Report on Jessore, pp. 85-86.

were directly involved in production, particularly in low wage areas like Bihar, women's major rôle was restricted to food processing, notably husking rice[12]. We shall therefore discount female labour in calculating our aggregate labour input.

Naturally, this stands in complete contrast to the Forth Valley, where female participation in agriculture was high and rose during the agricultural revolution. "Formerly, haytime and harvest were the only seasons, when women and others employed in sedentary labour were called forth; but under the system of improvement which has now taken place, the whole summer requires their aid"[13]. Female labour was in urgent demand for the intensive weeding and handhoeing required for the new fodder crops. Without cheap female labour, labour-intensive crops like turnips and potatoes could not be grown profitably. For instance, the potato "requires as much, if not more, culture than the turnip-; it takes much more labour to plant and take it up. This must prevent the potato from being very frequent, except in the neighbourhood of a town, or villages"[14]. Moreover, the shortage of male labour during

12. Manoshi Mitra, "Women in Colonial Agriculture: Bihar in the late 18th and the 19th Century". Development and change, vol. 12, No. 1, (Jan, 1981), pp. 29-54.

13. Sir John Sinclair, Analysis of the Statistical Account, p. 13, Appendix.

14. Reference mislaid.

the Napoleonic Wars further relaxed the sexual division of labour. "Women are now... pretty generally employed to do outwork, in which men only were formerly engaged", it was reported from the Forth Valley. "There are few operations of husbandry in which women are not employed at present, except those of ploughing and thrashing"[15].

The second factor determining the available labour supply is the duration of the working year. In Scotland, this varied according to the type of labour contract. Labourers hired by the day worked less of the year than permanent farm servants like ploughmen. After allowing for loss of earnings from sickness, bad weather and holidays, one careful estimate puts the number of weeks in which a labourer was available for employment as 48 out of a possible 52[16]. This is confirmed by farm accounts which show day-labourers employed for 48 weeks in the year[17]. Discounting Sundays, the duration of the working year was, therefore, 288 days. This is above other contemporary estimates. In Moray and Nairn, for example, it was reported that "The number of days in the year which a

15. Graham, General View Stirlinghsire, p. 313.

16. Margaret E. Goldie, The standard of living of the Scottish farm workers in selected areas at the time of the first two statistical accounts. (M.S.c. thesis, Edinburgh, 1971), p. 117.

17. Select Committee on Agricultural Distress, Parliamentary Papers, 18(2) 1836, q. 9694, Evidence - Robert Hope.

labourer counts on for wages is stated, at a medium, about 260 in a year", while in Banffshire, "Deducting for those days in which, from the inclemency of the weather, no work can be done out of doors, for Sundays and fast days set apart for divine worship, it is said that 100 may at least be taken off from the 365 days in the year"[18]. We shall therefore adopt two estimates, of 260 and 288 days in the working year. No similar contemporary estimates are available for Bengal. Modern data from Bangladesh defines full employment as between 240-275 days work in the year[19]. This is close to our lower estimate for 18th century Scotland. We shall therefore adopt 240 and 260 days as the length of the working year.

18. William Leslie, General View of Moray and Nairn, p. 349; David Souter, General View of the Agriculture of Banff (London, 1812), p. 268.

19. Iqbal Ahmed, "Unemployment and underemployment", p. 1288.

Section 2: seasonality

Employment in agriculture is irregular because production is seasonal. This effects the demand for labour. It may be, for example, that while large numbers of people are underemployed for most of the year, at harvest time everyone is fully employed. This kind of seasonal unemployment is quite different from the surplus labour we are trying to measure. In order to make the distinction, we must know the seasonal distribution of agricultural labour.

2:I Bengal.

All agricultural activity is regulated by the rains. The agricultural year begins in March, with the arrival of the Norwesters. The first season ends during the monsoon in the Bengali month of <u>Bhadra</u> (15th August-15th September) and is, therefore, known as <u>Bhadoi</u>. Before it ends, the second season is underway, starting with the monsoon proper in June. It takes the name <u>Haimantik</u> or <u>Aghani</u> since it coincides with the period between mid-October and mid-December when the <u>aman</u> crop is harvested. The year ends with the dry or <u>rabi</u> season from October to April.

Each of the three seasons overlaps since both sowing and ploughing depend on a highly varibale rainfall. The Norwesters are essential to soften the ground for preparatory ploughing in March. The monsoon rain determines the time of sowing, or "Jo":

> "The ryots are always guided by the chances of rain, and never sow till they are pretty sure no more is likely to fall. If a shower of rain falls just after sowing, however light it may be, it is very sensibly felt by the young crops, and they will never thrive so healthily as those which escape a wetting, the earth being at this period very damp, the smallest quantity causes the particles to bind together on the surface, and the soil to remain cold, and however vigourous the mould may be, the plants become meagre and poor"[20].

The rainfall scatter diagrams (Figs. 3-1 and 3-2) illustrate the annual distribution of rain in S & W and N & E Bengal over our period. The method clearly reveals the range of variation which the annual and even monthly totals conceal. The importance of the "jo" is obvious, Rainfall in Bengal was less variable than anywhere else in India. Whereas the average variability of monsoon rainfall in India is 20%, Fig. 3-2 shows that in N & E Bengal between 1890-1914, it was 15%[21].

20. C. H. Blake, "A Twelve Month's Agricultural Journal kept in the Poornea district, showing the occupations of each month, with remarks on the weather", Transactions of the Agricultural and Horticultural Society of India, vol. 1, (1829), pp. 229-230.
21. A.V. Williamson and K.G.T. Clark, "The Variability of the Rainfall of India "Quarterly Journal of the Royal Meteorological Society, vol. 57, (1931), p. 45. Formula on p. 63.

Figure 3.1

Rainfall scatter diagram,
southern & western Bengal 1890-1912
(inches)

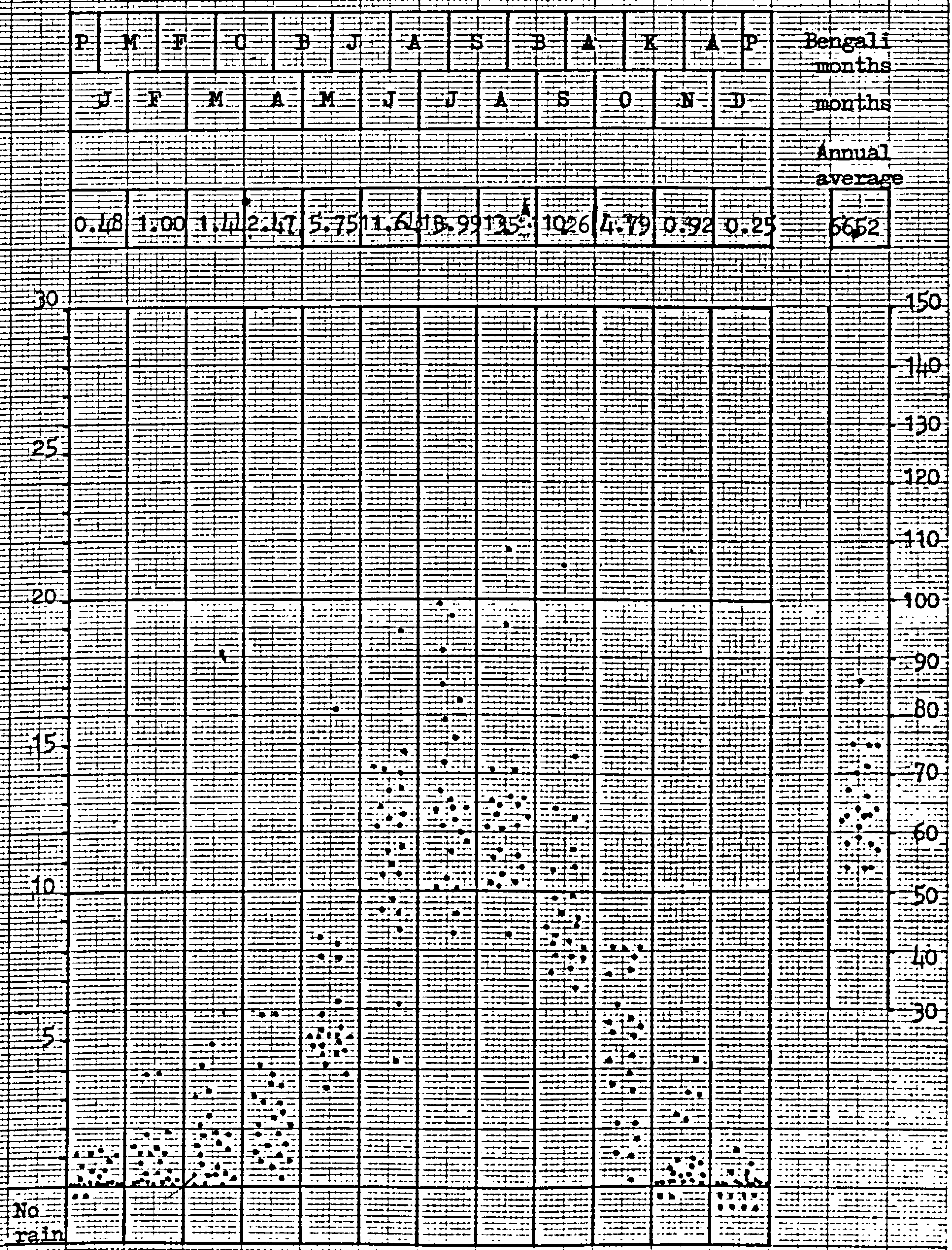


Figure 3.1

Rainfall scatter diagram,
southern & western Bengal 1890-1912
(inches)

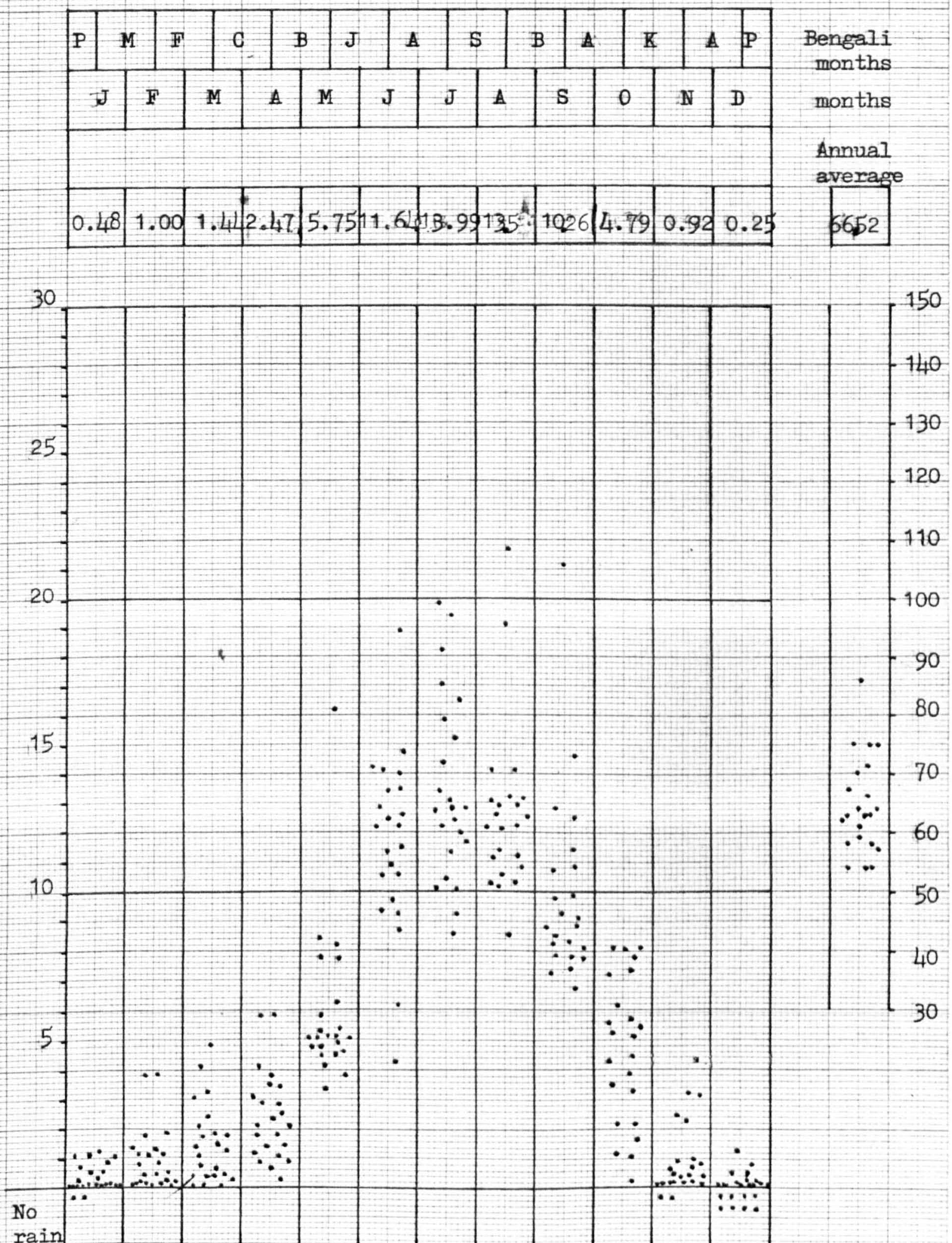


Figure 3.2

Rainfall scatter diagram,
northern & eastern Bengal 1890-1912
(inches)

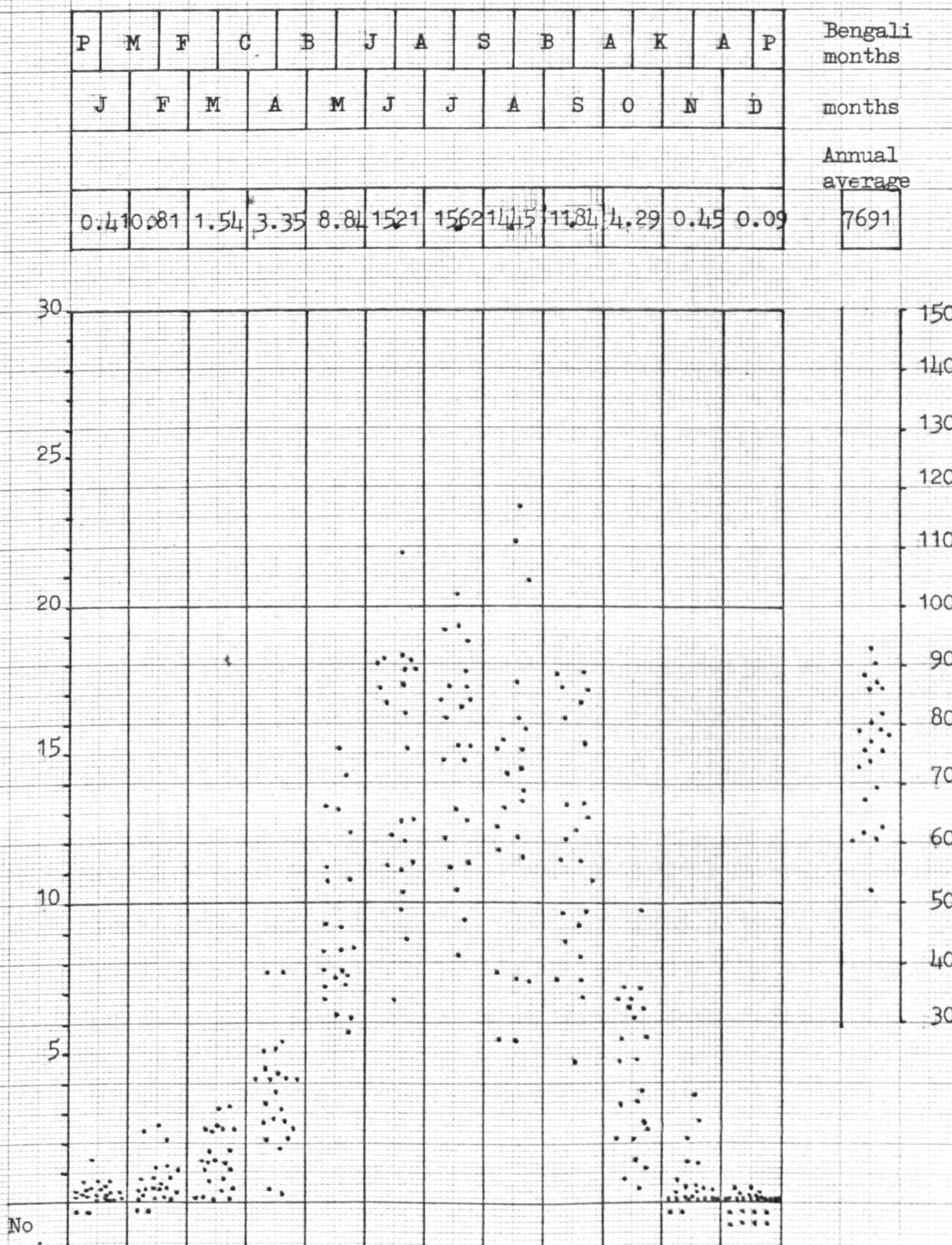


Figure 3.2

Rainfall scatter diagram,
northern & eastern Bengal 1890-1912
(inches)

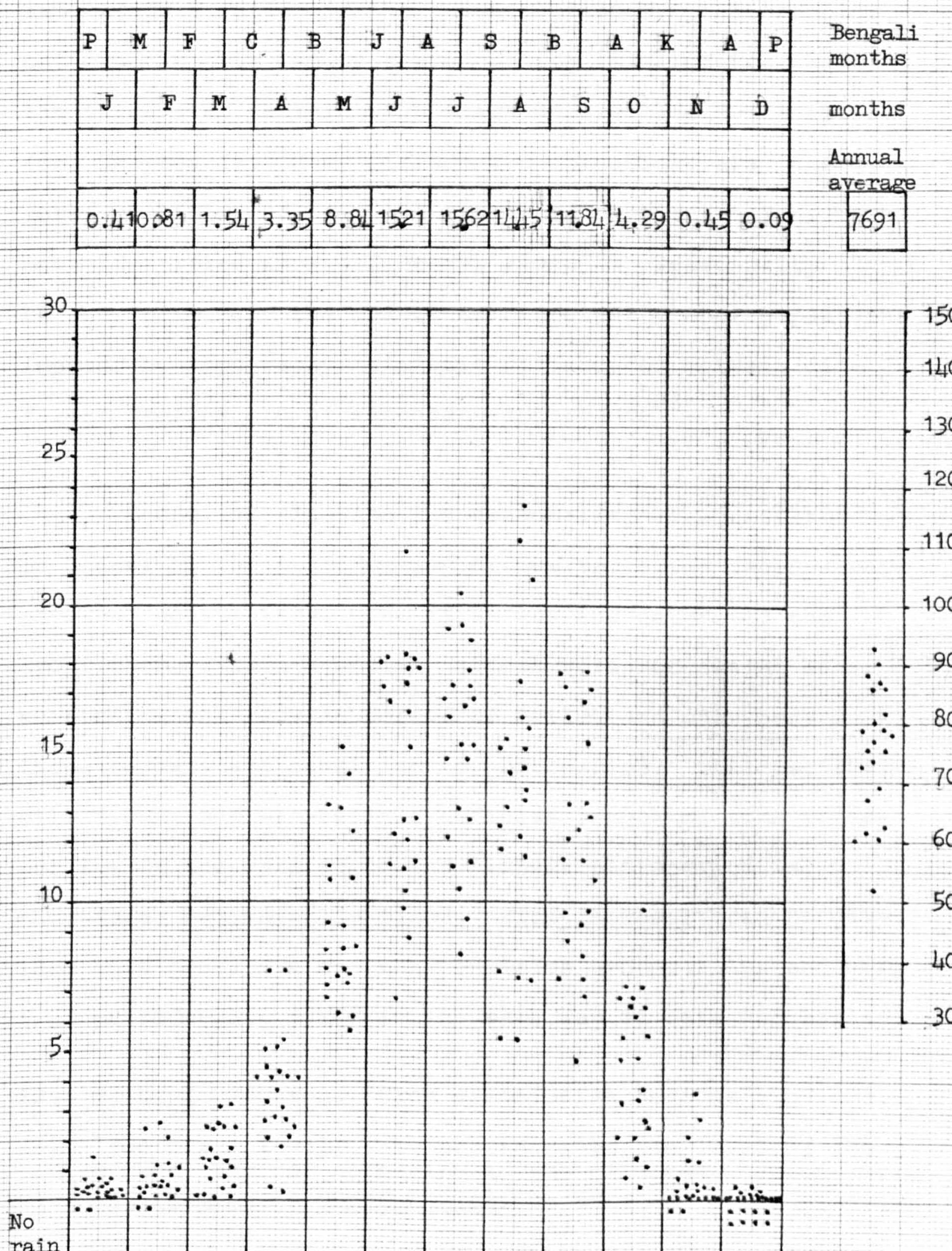
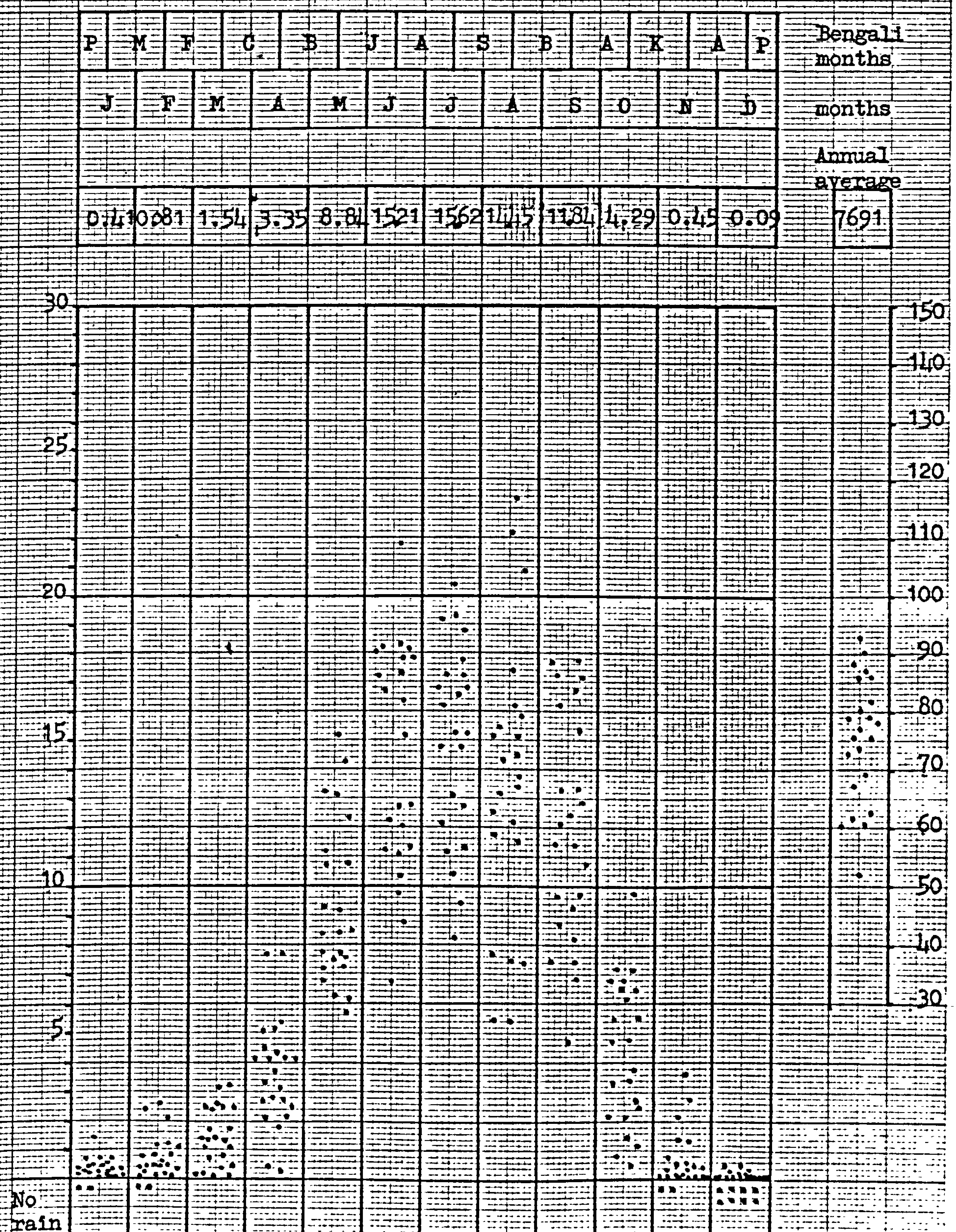


Figure 3.2

Rainfall scatter diagram,
northern & eastern Bengal 1890-1912
(inches)



Besides rainfall, the major physical determinant of seasonality in Bengal is topography, which dictates the extent and duration of the seasonal floods. The cropping patterns in each region depend on the level of the land, the three-step pattern with which we are already familiar. (See Chapter I). Many different combinations are therefore possible and over 150 crops-association regions have been identified in N & E Bengal alone[22]. Seasonality is thus primarily the result of different cropping patterns imposed by topography; climatic differences between different regions are of secondary importance[23].

Scope for altering the seasonality of agriculture in Bengal by the introduction of new varieties faced severe physical constraints. The first was the nature of the crops themselves. Scottish farmers were successful in shortening the growing period of barley and oats because these cereals are sensitive to photoperiod. That is, they will flower and mature in a definite length of time irrespective of the date of sowing. Their photoperiod is, therefore, periodically fixed. Rice, however, can be divided into sensitive and non-sensitive groups. Aus and boro are periodically fixed in the same way as oats and barley.

22. B. L. C. Johnson, "Crop Association Regions", p. 103.

23. "The harvest will vary according to the level of the ground, and not according to the climate". Seton-Karr, "Agriculture in Lower Bengal," p. 421.

They are nonsensitive to photoperiod and have a short growing season[24]. An exhaustive survey of aus varieties in eastern Bengal showed that their duration from sowing to maturity was between 90-124 days. The modal date of flowering was 30th July[25]. Aman is a timely fixed rice which can only be grown at a particular time of year. The same survey found that the duration of transplated aman in eastern Bengal ranged from 138-183 days, with the modal date of flowering 19th October. In other words, whenever aman was planted, it would always ripen in October.

This apparent inflexibility in seasonality is in fact a genetic form of risk-aversion. Farmers were guaranteed that no matter when aman was planted, it would receive the rain essential for maturity and ripening because it always flowered before the end of the monsoon. There was a second advantage to aman, besides being timely fixed. Numerous varieties had the unique ability to grow in deep water. They could be safely sown before the floods because they could actually grow faster than the floodwater rose. Deep water aman can grow 4-6 inches within 24 hours and attain a stem length of 20 feet enabling it to float above the floodwater[26]. No modern High Yielding Varieties

24. A. Alim and J. L. Sen, "Agricultural Classes of Paddy in East Pakistan". Agriculture Pakistan, vol. VIII., No. 3, (Sept. 1956), p. 218.

25. G.P. Hector et al, "Varietal Characters and Classification of Rices of East Bengal", Indian Journal of Agricultural Science, vol IV (Feb, 1934) p.20.

26. Alim and Sen, op. cit., p. 230.

possess either this or the timely fixed quality of aman and so far this has prevented their introduction in Bangladesh.

Yet even so versatile a crop as aman was powerless before the variability of the monsoon rains. The Famine Commission of the 1880's reported that three periods of rainfall were essential for the crop's success. The first was in May and June, when light rain was required for sowing, the second in July and August, when heavy rain was required for weeding and transplanting. The third and final period was in September and October, for "maturing the growth and filling out the ear". As we know, this was the modal date for flowering. Without rain at this point, the period of grain development from fertilisation to maturity was impossible. Hence, as the Famine Commissioners recognised, "The last of these stages is the most critical, and it is to the failure of the rains in September and October that all famine in Bengal have been due"[27]. Aman, the staple rice of Bengal, is thus a particularly cruel example of the truth expressed by Sebastien Mercier: "The corn which feeds man is also his executioner".

A second disadvantage of aman's genetic programming was that its cultivation could not be extended by irriga-

27. quoted by Sir George Watt, A dictionary of the economic products of India, (Calcutta, 1889-96), vol V, p. 534.

tion during the dry season[28]. Only aus or boro could be used since they were periodically fixed. Both ranked below aman in terms of consumer preference and were not normally sold but kept for home consumption. Reducing seasonal unemployment by extending rice cultivation through the dry season was, therefore, less profitable than it would have been with aman.

2.2. The Forth Valley

Scottish farmers faced quite different problems. Temperature, not rainfall, was the fundamental climatic constraint. Winter meant that there was no possibility of extending the growing season (defined as the number of months with a mean temperature above 42.8 degrees F) to twelve months in the year as in Bengal. Instead the growing season in the Forth Valley was limited to some seven or eight months and even less on high ground.[29] Moreover, as the climate changed, winters became longer and colder as the eighteenth century progressed. This contraction in the length of the growing season, making harvests later and more perilous, lay behind important changes in the seasonality of Scottish agriculture.

28. Obaedul Huq, "Dry Season Fallow in East Pakistan: Problems and Prospects", Oriental Geographer, vol. x, No. 2, (July, 1966), p. 99.

29. S. Gregory, "Accumulated Temperature Maps of the British Isles", Transactions of the Institute of British Geographers, vol. 20, (1954), pp. 59-74.

New varieties of the staple cereal crops were introduced. These were of higher quality than the old, coarser grains they replaced. "Bear", for example, was the staple foodgrain in the Forth Valley in the 1760's. It was a coarse variety of barley but with advantages which finer kinds lacked. "It is well known, that it produces more seeds than barley, and is less injurious to the ground; and may be sown for twenty years on the same ground in succession, without either lessening the produce or impairing (sic) the yield, provided the land is fallowed before winter, and twice ploughed before sowing, with a sprinkling of dung or seaware"[30]. Oats underwent a similar change in quality. Three varieties were sown in the Forth Valley in the 1760's. Two - "grey oats" (avena strigosa) and "bruikit" oats (a mixture of grey and white oats) - were extremely coarse grains. During the eighteenth century they gradually lost their market, and from 1799 onwards their prices were no longer quoted in the records of the Stirlingshire Fiars court. "No such grain now sown in this county", noted the clerk[31]. White oats (avena sativa) had by then become the preferred variety.

One of the major advantages of thecoarser varieties had been their short photoperiod. Bear ripened more quickly than barley. "It is very seldom more than ten weeks on the ground in favourable situations, and barley never less than

30. Sinclair, Materials, vol. 1, p. 267 note.

31. Stirling Fiars Prices, 1799, Scottish Record Office.

fourteen"[32]. Another source adds the qualification that, while bear "has been reaped in the tenth week after it was sown: it is generally ripe in the twelfth week..."[33]. But even a fortnight's delay in harvesting was critical. The introduction of finer varieties with longer photo-periods forced farmers to change the timing of cultivation practices to permit early sowing. Tenant farmers were exhorted to imitate those "who, by a proper application of drainings, ploughings, manurings, water-furrowings have forwarded the barley-seed time a month, yea two months more than was formerly the case upon these grounds...[34]. No doubt the achievement was exaggerated but more flexible crop calendars were possible than in Bengal where sowing was impossible without rain.

Successful attempts were also made to find varieties of avena sativa which ripened early, "a circumstance of great importance in so precarious a climate as this"[35]. The "potato" or red oat was introduced into the Forth Valley

32. Sinclair, ibid.

33. Leslie, General View of Morav and Nairn, p. 171.

34. "The Farmer's Kalendar. March". Scots Farmer, vol. 2, Article XXVII, p. 167 note.

35. Graham, Gēneral View of Stirlingshire, p. 157.

in the 1790's. Reports suggest it ripened from two to four weeks earlier than ordinary white oats[36]. But the potato was soon rivalled by the Hopetoun oat, which ripened a few days earlier still[37]. The search for early varieties extended abroad to Sweden, Poland and Friesland. Some of these found their way to the Forth Valley. "A new variety of the oat was introduced from Sweden into this country a few years ago... and is, everywhere, a week earlier than the Potato-Oat under similar circumstances"[38]. Genrally speaking, however, no major advance was made on the potato oat. Early Fellow, which appeared in the 1860's, ripened only five or six days earlier[39].

But the most striking example of adaptation to changing seasonality is not the potato oat but the humble potato itself. The potato was brought to Europe from South America as early as the sixteenth century. Yet it was not grown as a field crop in Scotland till 1739, when

36. OSA, vol. IX, p. 360 (Gargunnock); Robertson, General View of Perthshire, p. 155.

37. William M. Findlay, Oats. Their cultivation and use from ancient time to the present day, (Edinburgh 1956), p. 31.

38. Farmers Magazine, vol. 19 (1818), Agricultural Intelligence - Scotland. Quarterly Report, Stirlingshire, 3 February 1818, p. 121.

39. Patrick Shireff,. Improvement of the Cereals and an essay on the wheat fly, (Edinburgh, 1893), p. 12.

it was planted by a farm labourer in the Forth Valley. Two dates, one problem. Why did it take so long for the potato to become a Scottish staple?

A botanist has given us the answer. The South American potato (solanarum) has two subspecies with different photoperiods. Solanarum tuberosum responds to the long, summer daylengths of 18 hours found in temperate regions and is, therefore, ideally suited to the European climate. But its counterpart, solanarum andigina, only responds to twelve hour daylengths. We now know that it was the second and not the first subspecies which the conquistadores brought back from New Spain. As a result, by the time s. andigina started growing in September, the cooler temperature slowed down its general metabolism and winter frosts destroyed the possibility of a mature crop. Two hundred years of selective breeding were necessary to discover the earliest and highest-yielding plants. By the eighteenth century, Europe's gardeners had effectively transformed one subspecies into another and the potato could be grown successfuly as a field crop. What seems at first sight a story of collective conservatism turns out to be a remarkable achievement[40].

The adaptation of new varieties proved less of a problem for Scottish farmers than it does for Bengali

40. J. G. Hawkes, "The History of the Potato. Masters Memorial Lecture, 1966". Journal of the Royal Horticultural Society, vol. XCII, (1967), pp. 207-224, 249-262, 288-302.

farmers today. Farmers in the Forth Valley were able to reconcile the conflicting demands made by a changing climate and changing market forces. They were successful because a seasonality based on temperature is easier to circumvent than one based on rainfall. Scottish cereals were not dependent on rain for sowing and ripening. Cultivation practices could therefore be improved to permit early sowing and harvests brought forward since the crops were periodically fixed. The resulting change in seasonality worked to their advantage. The corn which was once man's executioner was now his servant.

2-3 Crop Calendars

A uniform crop calendar for the Forth Valley was reconstructed from the average dates of sowing and harvest recorded for eight parishes. Inevitably, there were variations : the higher western half of the Valley was always behind the lower and warmer eastern end. As the reporter for Kippen parish explained, "We are upon the whole three weeks later than east Lothian, and often a fortnight later than our neighbours in the vicinity of Stirling. Seldom does the seed labour begin before the beginning of March, and not infrequently the end of that month approaches, before the fields are dry enough for the plough... Harvest is seldom over before the middle or end of October and the corn is sometimes standing out even when the month of November is advanced"[41]. A second source of variation in the crop calendar of the region was the difference in soil between carse and dryfield farms. A comparison of the relative dates of sowing and harvest in the central parish of Kilmadock shows that on average dryfield farmers were some two weeks behind those on the carse[42]. The crop calendar outlined below simplifies these local differences and therefore cannot pretend to complete accuracy.

41. OSA, vol. IX, pp. 539-540 (Kippen).

42. OSA, Vol. XII, p. 542 (Kilmadock / Doune).

The parish entries record dates only for sowing and harvest. A general picture of seasonal labour patterns was therefore obtained from other sources, notably "diaries" of farm operations[43]. In the absence of precise information on the timing of cultivation practices, trapezoid distributions were assumed, with the intensity of activity rising to a maximum after 14 days and similarly declining to zero over the last 14 days in which the operations can be assumed to have been performed. This simplified type of distribution is the closest we can get to the reality.

2.3.I Oats

Oats were sown in March, "as early as possible", stressed one account. Further west in Callander and Kilsyth the beginning of April was often the earliest possible date. If we accept March as the usual month for sowing, ploughing must, therefore, have begun in February. Harvest was usually from the middle to the end of September (Kilmadock, St. Ninians). Thrashing occupied the winter months.

2.3.2 Barley

May was normally the month for sowing (Callander, Kilmadock, Lecropt). The first week of April is also mentioned in Kincardine and Kilsyth. Ploughing must there-

43. Sinclair, Materials, Addenda, pp. 13-18.

fore have begun in February. Barley was the first cereal crop to be harvested. All parishes report August as the harvest month, with the exception of Callander, which records September.

2.3.3 Wheat

Since wheat followed summer fallow in the rotation, preparatory ploughing began in October and continued in the new year. The land was manured in January. Wheat was normally sown in September (Kilmadock, Lecropt, Kincardine) but could safely be sown anytime before the Ist of November (St. Ninians). Harvest was generally in August (Kilmadock, Kincardine, Lecropt).

2.3.4 Peas and Beans

A fodder crop of peas and beans was sown in March (Kilmadock, St. Ninians, Kincardine). Farmers always tried to sow them before oats (Airth). No extensive preparations were necessary and ploughing could be done in March immediately prior to sowing. September saw the harvest in most parishes (Kilmadock, Kincardine, St. Ninians).

2.3.5. Turnips

Information on turnips is scanty since they were rarely grown in the Forth Valley. June was the normal month for sowing in the dryfield (Callander, Lecropt). Harvest, when the crop was pulled, came in October or November.

2.3.6. Potatoes

Planting was generally in May (Kilsyth, Callander, Lecropt). Two parishes reported early or late April (Kilsyth, Kilmadock). Depending on the variety, the crop was lifted in either August or September. (Callender, Kilmadock).

2.3.7. Ryegrass and clover

Sowing was in March and the hay harvest spanned June and July.

2.3.8. Summer fallow

The first ploughing was given as soon as possible after the sowing of the winter wheat in September. Weeding was normally in June. The field was rolled in July in preparation for wheat sowing in August[44].

Broadly speaking the Bengal delta lies within the same climatic zone. Bioclimatic law dictates that the flowering of rice will be delayed by 3.8 days for each additional degree of latitude: hence, the four degrees of latitude between north and south Bengal will mean a differences of less than two weeks in flowering dates[45]. What differences there are in the cropping calendars between regions are therefore relatively small and are due to different rainfall regimes. The two rainfall scatter diagrams show that N & E Bengal has a heavier rainfall than S & W Bengal in March, April and May. This is the period of the Norwesters, whose importance for agriculture has already been explained. The crop calendar of the S & W are therefore slightly behind N & E. Nonetheless, the correlation is sufficiently close to permit us to use a uniform crop calendar.

2.3.9 Aus

Land for *aus* was prepared "as rapidly as possible" after the preceding *rabi* crops had been harvested, in order

44. Sinclair, *ibid*, pp. 235-6.

45. A. K. Mallick, "Climatology of the Crop Seasons of India - Rice", *Indian Journal of Meteorology and Geophysics*, vol. 15, Part. 44, (1964), p. 558.

to sow with the first showers of the monsoon. Ploughing therefore began in February, although it was noted in Jessore that ploughing did not start in earnest till March. Sowing was usually from mid-April to mid-May. The period was necessarily flexible since the main objective was to sow well before the floods rose, and they did not rise at the same time everywhere. Ploughing and weeding continued in June. Harvest followed in August and September[46].

2.3.10 B. Aman

Ploughing began in December, immediately the preceding crop was off the ground. The land was left exposed to the sun and rain till March, when ploughing started again. Repeated ploughings followed till the monsoon showers. Sowing occurred between mid-April and mid-May. Weeding was generally in June. Harvest was in November and December. Thrashing continued into January[47].

46. Sen, Report on Dacca, pp. 29, 31; J. E. Gastrell, Geographical and statistical report of the Districts of Jessore, Fureedpore and Bakergunge. (Calcutta, 1868), Appendix, p. viii.
Allen, Dacca Gazetteer, p. 92; Blake, "Agricultural Journal", p. 222; O'Malley, Purnea Gazetteer, p. 86; Peterson, Burdwan Gazetteer, p. 93; Sen, Report on Jessore, p. 44.

47. Sen, Report on Dacca, p. 29; Sen, Report on Jessore, p. 44; Blake, "Agricultural Journal", pp. 222, 242, O'Malley, Purnea Gazetteer, p. 86.

2.3.11 T. Aman

Nursery ploughing began in April and May. In June, the *ails* or embankments surrounding the rice field proper were repaired. Transplanting dates seem to have depended greatly on the variety. For example, coarse *aman* was transplanted as early as May, while some finer varieties might not be transplanted till September. Generally, however, coarser varieties did not repay the labour of transplanting. July and August were therefore the most common months. Weeding and irrigation occupited the interval before harvest, which followed in November and December. Thrashing continued into January[48].

2.3.12 Oilseeds (mustard)

The commonest variety of mustard was sown in October, afte r jute. Ploughing was therefore in September or October. Harvest came between February and March[49].

48. Sen, *Report on Dacca*, p. 30-1; Peterson, *Burdwan Gazetteer*, p. 94; Hunter, *SAB*, vol XV, p. 283, (Purnea), vol IV, p. 70(Burdwan); Blake, "Agricultural Journal", 227-8, 242; O'Malley, *Purnea Gazetteer*, p. 95.

49. Sen, *Report on Dacca*, p. 53; Gastrell, *Report on Jessore*, Appendix; Hunter, *SAB*, vol. XV, p. 286 (Purnea), IV, p. 71 (Burdwan); Allen, *Dacca Gaseteer*, p. 95.

2.3.13 Khesari

No preparation was necessary when khesari was sown on aman land in November, It was harvested in February and March[50].

2.3.14 Jute

February saw the start of preparatory ploughing on low land, whereas on higher ground ploughing followed the first monsoon showers in March. Harvesting took place between July and October. Retting typically lasted a month[51].

2.3.15 Sugar

Land preparation took placein October and November. Planting was generally in February and March. The seedlings were irrigated and hoed up till June, when the canes were earthed up. Tying up took place between July and August. Sugar cane was cut and processed simultaneously in Febrary and March[52].

50. Hunter, SAB, vol. XV, p. 286 (Purnea), vol. IV, p. 71, Gastrell, Report on Jessore, Appendix; Sen, Report on Dacca, p. 48.

51. Allen, Dacca Gazetteer, p. 97; Sen, Report on Dacca, p. 51.

52. Sen, Report on Burdwan, pp. 24-25; Carstairs, Chanditala Thana, p. 25.

2.3.16 Boro

Boro was sown on low-lying alluvial land as the floods receded. "As the floods retire in the end of October, but whilst a few inches of water still remain, the land is ploughed; and as the inundated area grows smaller during the whole of November, more land is similarly added". Sowing was generally in November. The seedings were transplanted about a month after sowing, in December or January. Times of harvesting depended on the variety sown; one ripened in merely sixty days. But generally April and May were the harvest months[53].

2.3.17 Tobacco

Land for tobacco was prepared in September, as soon as the nursery seed bed had been sown. Ploughing was complete by the end of September. Transplanting took place in October. Manuring, weeding and irrigating were continuous before harvest in February. By March, the leaves were dry and ready for sale[54].

53. *SAB*, vol. 2, p. 242 (Jessore), vol. 5, p. 82 (Dacca), vol. 15, p. 282 (Purnea); Allen, *Dacca Gazetteer*, p. 91; O'Malley, *Purnea Gazetteer*, p. 88.

54. Hunter, *SAB*, vol. XV, pp. 288-290 (Purnea).

2.3.18 Wheat

Ploughing for wheat began in September and was complete by the end of October. The crop was usually sown in October. By January, it was in the ear and harvest followed in February and March[55].

2:4 Seasonal Labour Cycles

"A rice field", muses Fernand Braudel, "is a factory"[56]. Where farmers in the Forth Valley harvested all their grain crops within a month, Bengali farmers looked forward to three separate harvests in the course of the year. Besides _aus_, there were two types of _aman_ (transplanted and broadcast) and two types of _boro_ (early and late). As a European observed: "A proprietor of an estate with fairly mixed soil according to this system might have three, if not four or even five, harvests of rice every twelve months. Two harvests are all but universal in Bengal, with an occasional third but smaller one"[57]. Scope for reducing seasonal unemployment in Bengal was therefore much more limited than in Scotland.

55. Blake, "Agricultural Journal", pp. 229, 233, 243, 247.

56. F. Braudel, _Capitalism_, p. 102.

57. Watt, _Dictionary_, vol. 5, p. 531.

By contrast, agriculture in the Forth Valley before its transformation was characterised by a high degree of seasonality. One improver described infield-outfield in these terms. "The farmer, in ancient times seldom reared any crop but oats, a little barley, and peas. With them he sowed his infield constantly, and his outfield occasionally when not in grass. Hence, a small farm rendered him hurried in time of seed and harvest, and the manufacturing it occupied his whole labour during winter. In summer, he was literally idle"[58]. In fact, farmers were far from idle. The slack season was occupied by work off the farm, digging peat to supply fuel essential for the winter. This labour bottleneck prevented the adoption of improved cultivation practices like carrying lime or sowing turnips. Without cheap coal, attempts to reduce seasonal unemployment on the farm were impracticable.

Given alternative sources of fuel, however, a change in the allocation of crops was still essential. Green fodder crops were the key to the new rotations, since they enabled the plough animals to be worked throughout the summer. "Destitute as most tenants were, of food for the working stock, it was impracticable to obtain labour from their horses, of any consequence... A few hours work before breakfast, constituted the morning yoking; after

58. OSA, vol. XII, p. 516, (Kilmadock/Doune).

which the horses were taken to the outfield pastures to give them strength for another short yoking in the afternoon"[59]. In some areas of the Forth Valley, plough animals were not worked at all during summer, but despatched to graze on the uplands for five months. With the introduction of clover and ryegrass, the fodder shortage was solved and ploughing became possible in summer. The consequent reduction in unit seasonal unemployment meant a saving in unit labour costs, as farmers were well aware.

"The principal thing in economy, wrote one, "is to have an uninterrupted succession of useful labour during all the seasons of the year". Central to this objective was the rotation. "The succession of labour must be kept in view in every scheme that is proposed. For it is certain, that a scheme, though most spacious upon paper, and which might succeed very well if we had strength at command, and were obliged to pay for labourers and labouring cattle only when we used them; yet, if it requires more labout at one time and less at another, than the ordinary schemes of management, will upon trial be rejected"[60]. Lord Kames in similar vein advised farmers against "crowding crops one after another point of time;... use such as admit intervals sufficient for leisurely dressing, which gives opportunity to manage all with the same hands and the same cattle"[61].

59. "A Comparative View of East Lothian Husbandry in 1778 and 1810, Part I", Farmers Magazine, vol. 12, No. XLV (March 1811), p. 53.

60. Reference mislaid.

61. Lord Kames, The Gentleman Farmer. (Edinburgh, 1776, 2nd ed.) p. 280.

A six course rotation of the kind used on Carse farms in the Forth Valley successfully met these criteria. "The most prominent (advantage) certainly is, the equal distribution of farm labour; so that the sowing of each kind of grain follows another in regular succession, thereby enabling the farmer to execute all his operations in the best style"[62].

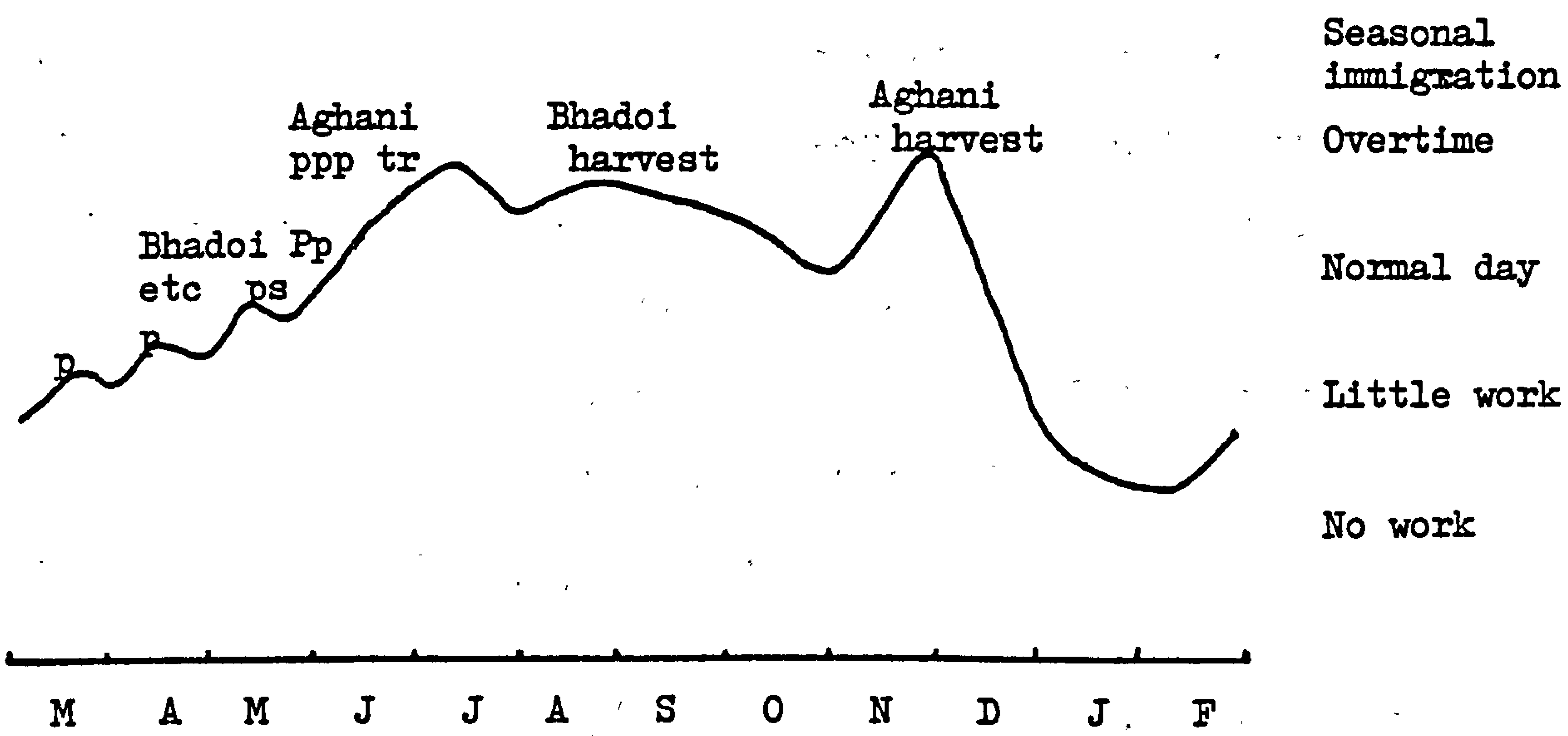
In Bengal, however, far from declining, seasonal unemployment was actually on the increase. This was the most important change in seasonality during our period. In the western half of the delta, the shift in the river system led to a fall in land productivity. One of the consequences was a progressive decline in the area growing <u>rabi</u> crops. Touring Burdwan in the early 192o's, the geographer Arthur Geddes reported: "In West Bengal, a <u>rabi</u> crop is now rarely grown". Even the memory of such a crop was fading, "for I have heard it said by younger men that 'it was always as now'"[63]. As a result, there was virtually no agricultural labour after the <u>aman</u> harvest until the spring. Geddes estimated seasonal unemployment for men and work animals at fully five months out of twelve. His graph is reproduced in Fig. 3-3. It indicates employment opportunities above or below certain critical levels of intensity:

62. Observator, "On a Suitable Rotation of Crops", <u>Farmers Magazine</u>, vol. 5, (1804), p. 280.

63. Geddes, <u>Human Geography of Bengal</u>, vol. 1, p. 519.

Figure 3.3

Graph of working days in the Cultivator's Year in the Western Uplands, showing idle period in Rabi Season - based on personal observation and enquiry (1923)



Key

p	preparation
s	sowing
t	transplanting

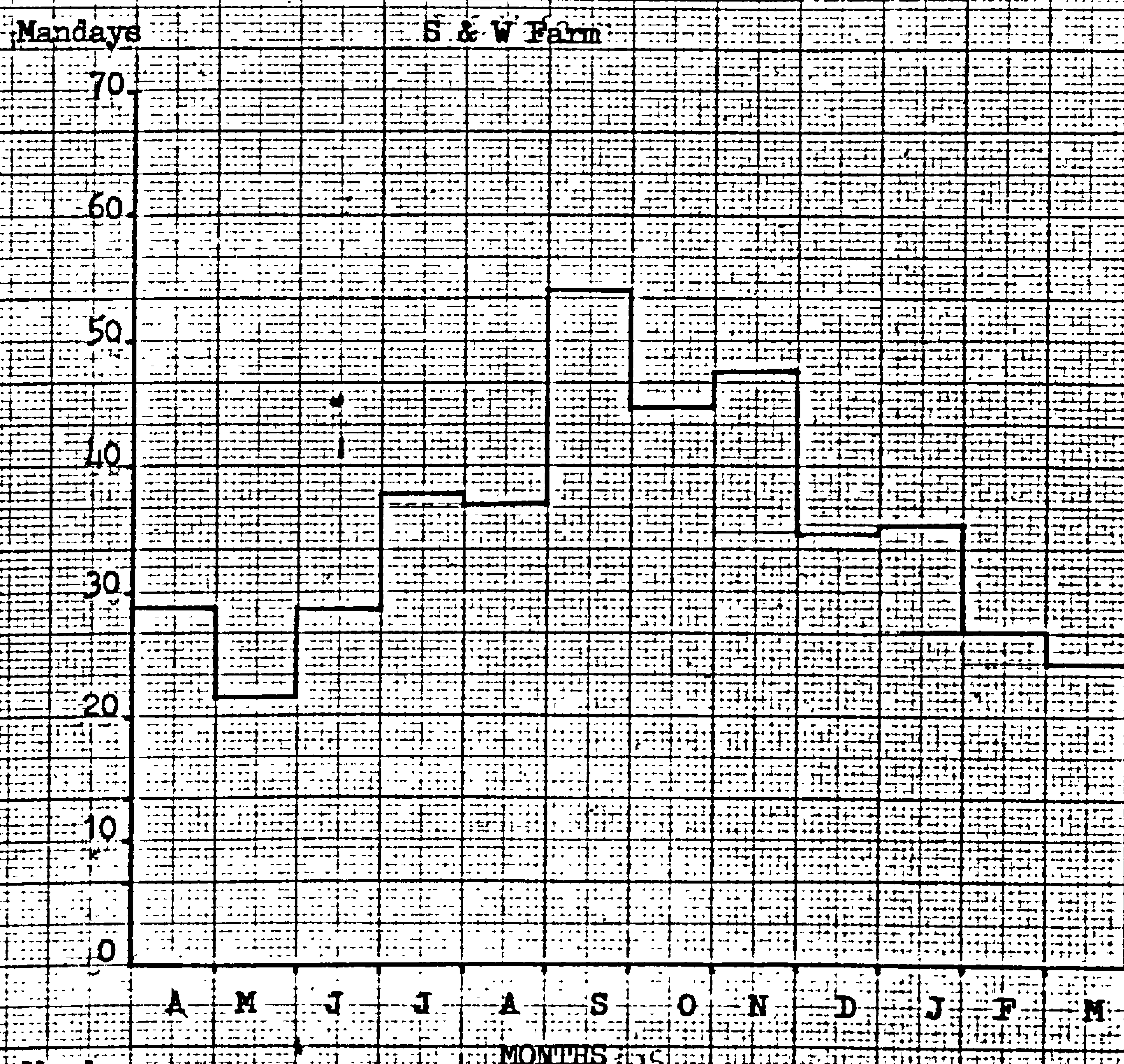
(I) underemployment or unemployment, (2) light employment, (3) full employment, (4) "overtime", "above which it is necessary to call in local women workers or, if the land is one of fairly rich crops, immigrant labourers". Despite the subjectivity of some of the categories, the increase in seasonality in western Bengal is beyond doubt.

The seasonal distribution of labour in both agricultural systems was compared by constructing monthly totals of labour input per acre. These were based on the crop calendars given in the previous section, using data on labour productivity drawn from Chapter 2. The per acre indexes were then used to calculate totals for average-sized farms (See Appendix E). Seasonal labour patterns for plough animals were calculated separately.

The histograms show that Bengal compares favourably with the Forth Valley in terms of total seasonal employment (Figs. 3-4 and 3-5). In both N & E and S & W Bengal there is virtually no difference between the mean and median monthly totals, evidence of an even seasonal distribution. Even the dry season months from October to January do not interrupt the pattern of regular labour, since they overlap with the harvesting and thrashing of <u>aman</u>. The marked seasonal peak in N & E Bengal in September and October reflects the labour required for processing jute.

Figure 3.4

Seasonal distribution of crop labour requirements, S & W Bengal



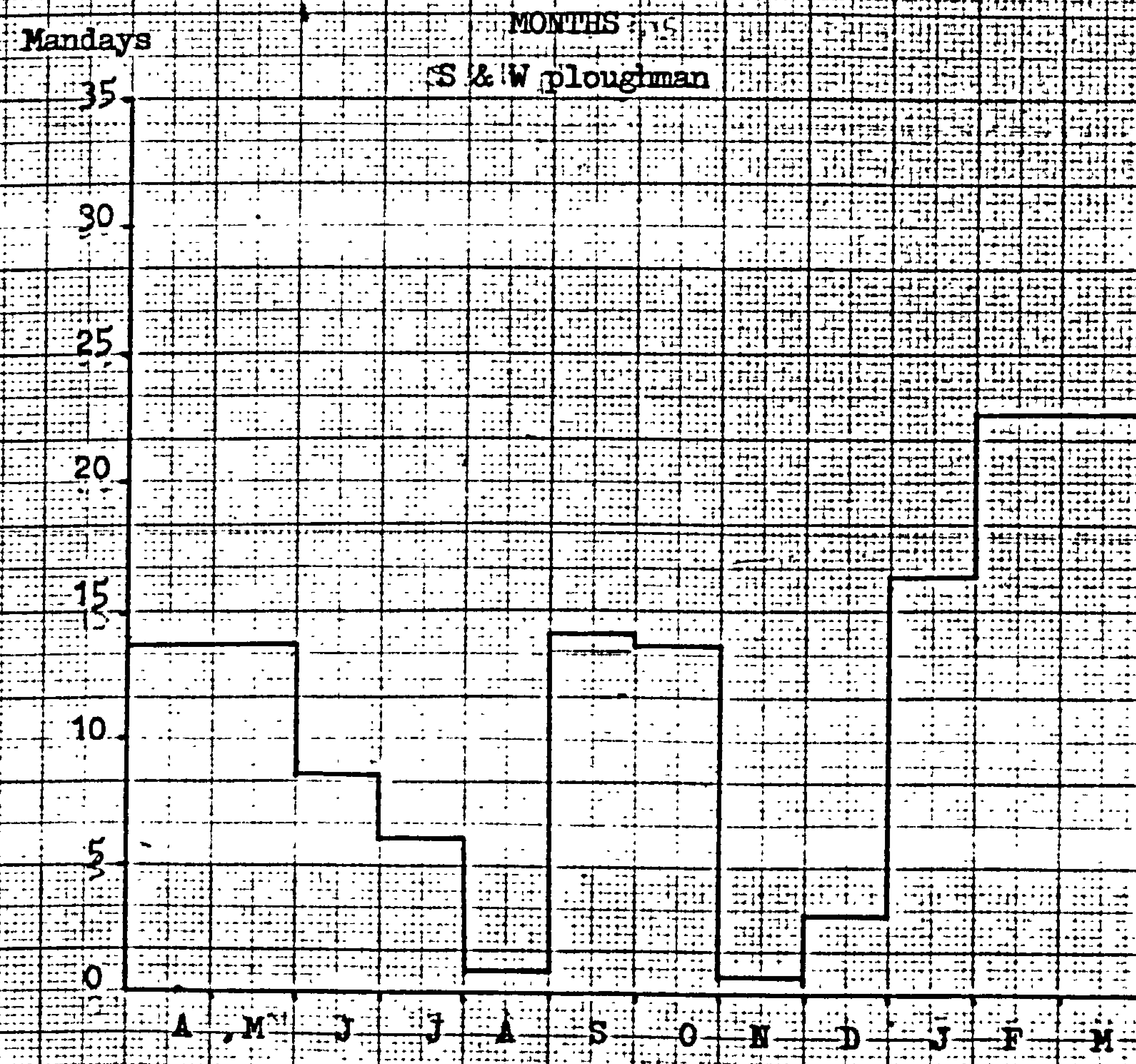
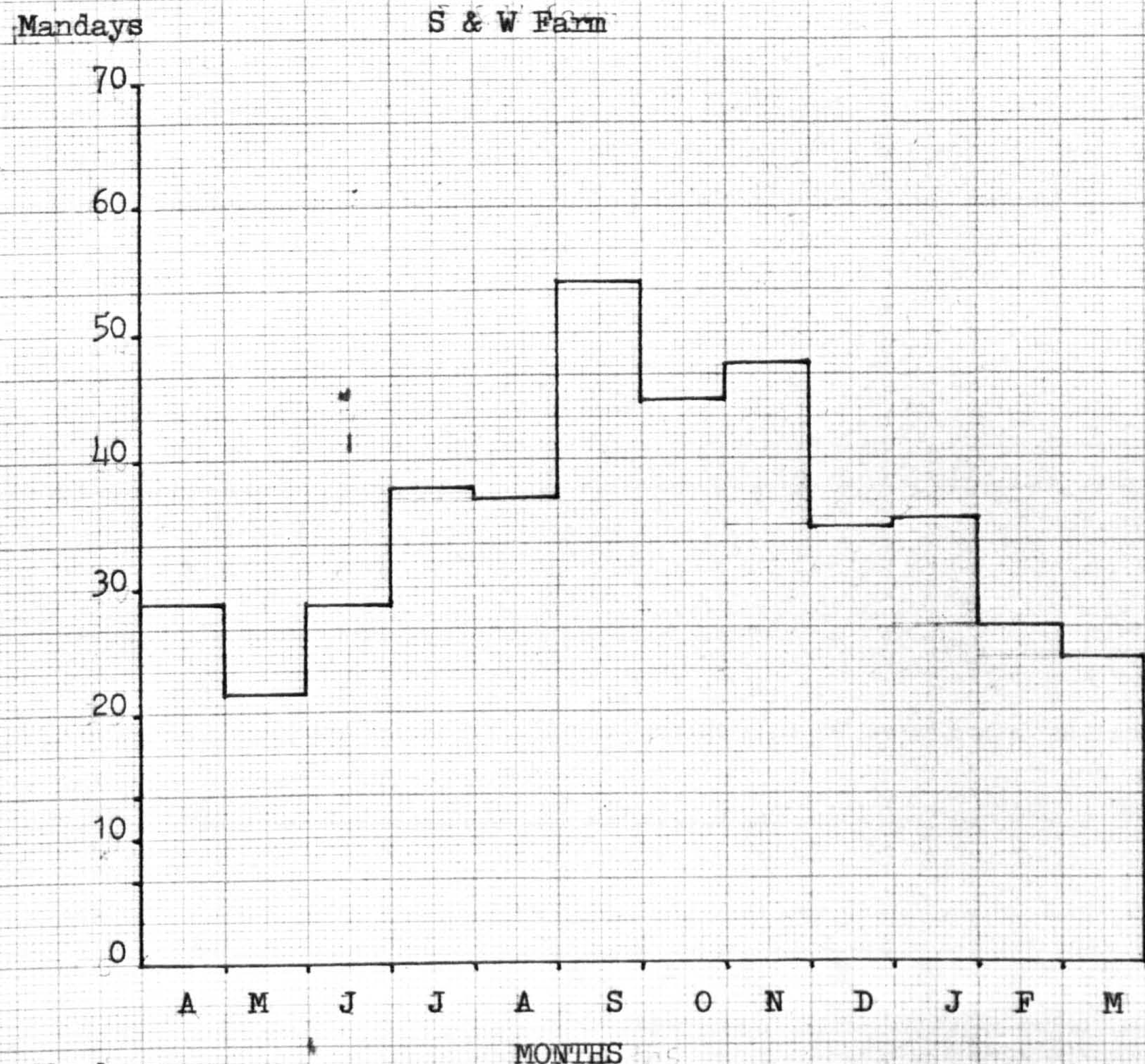


Figure 3.4

Seasonal distribution of crop labour reauirements, S & W Bengal



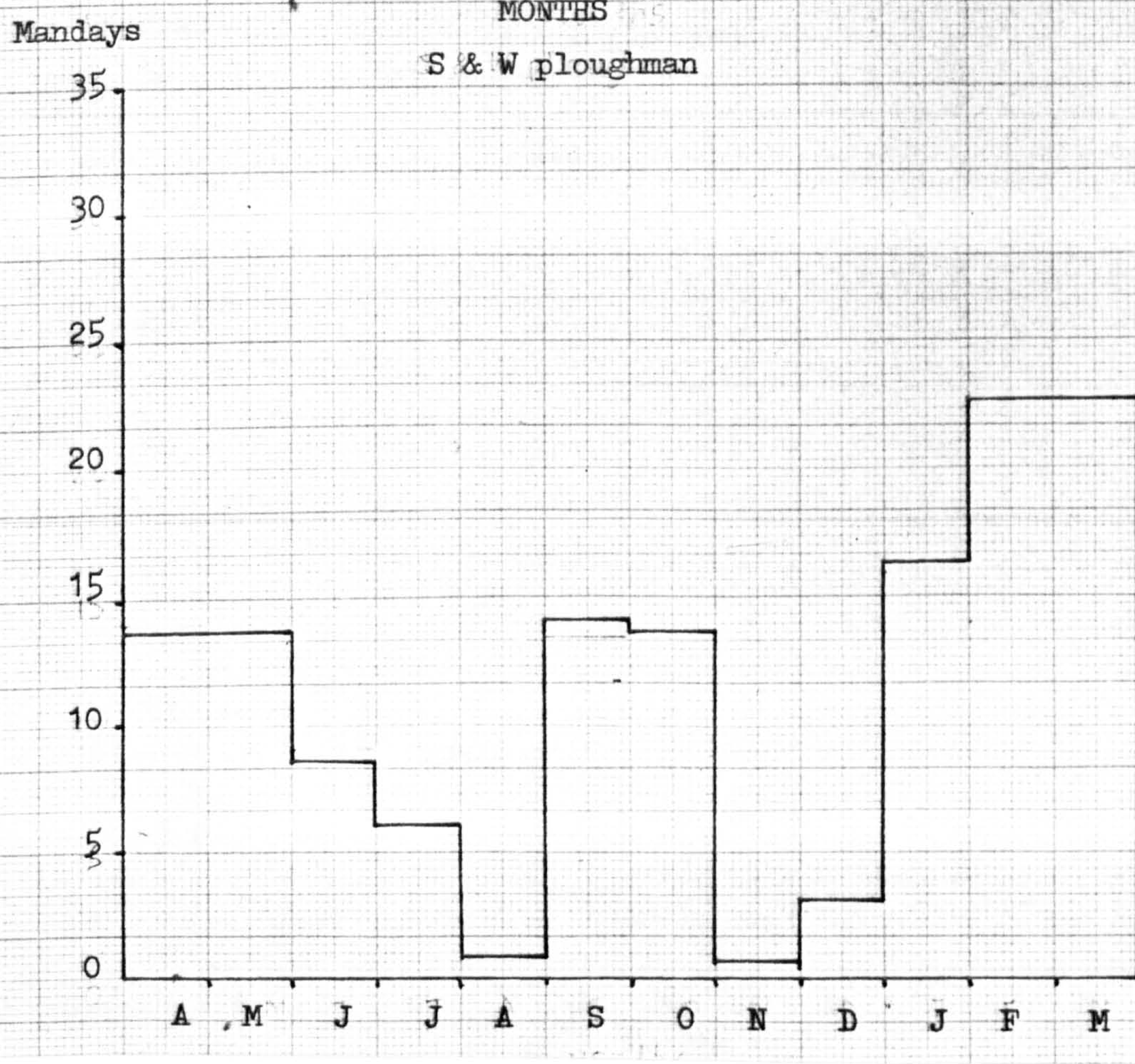
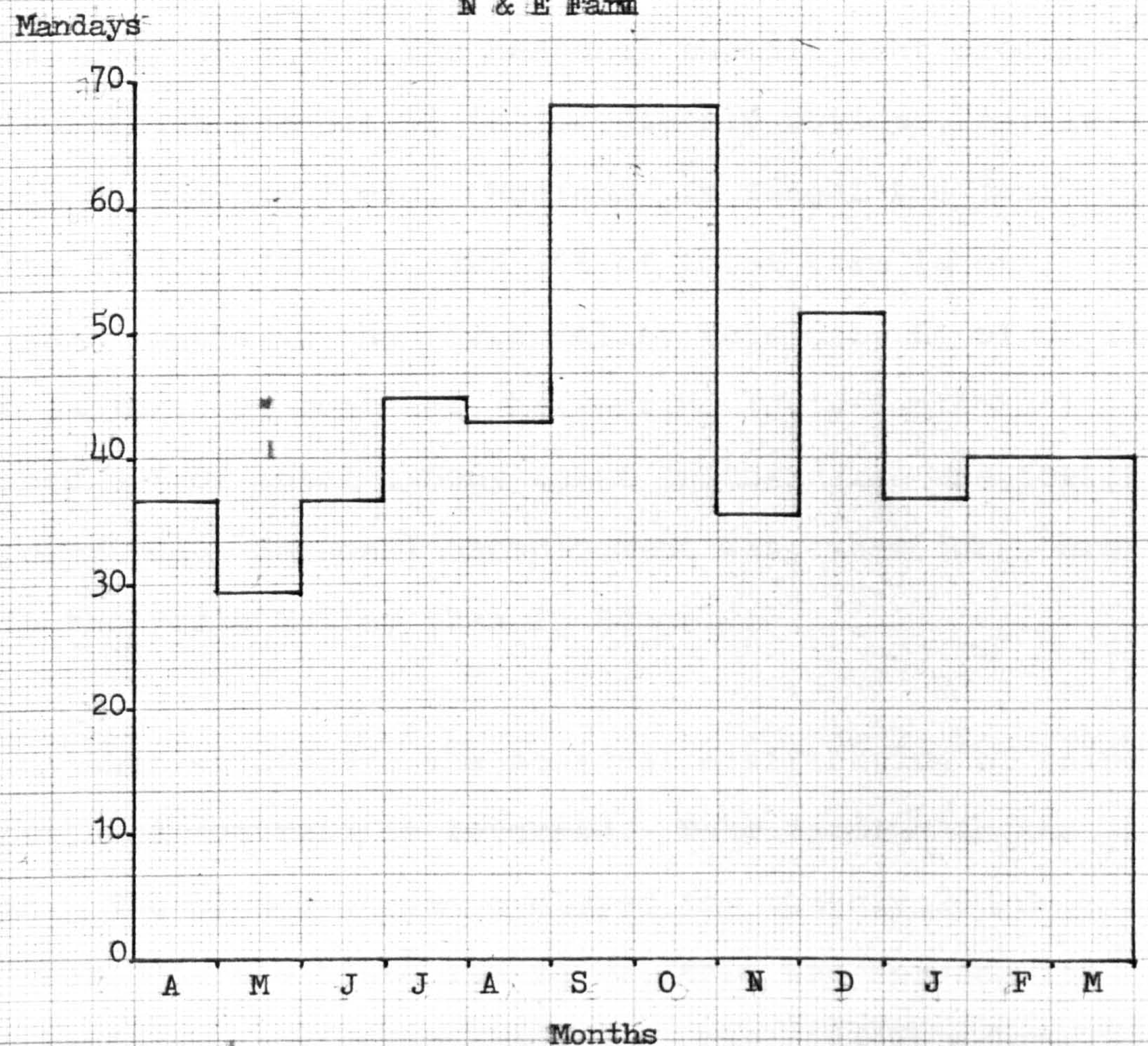


Figure 3.5

Seasonal distribution of crop labour requirements, N & E Bengal,

N & E Farm



N & E ploughman

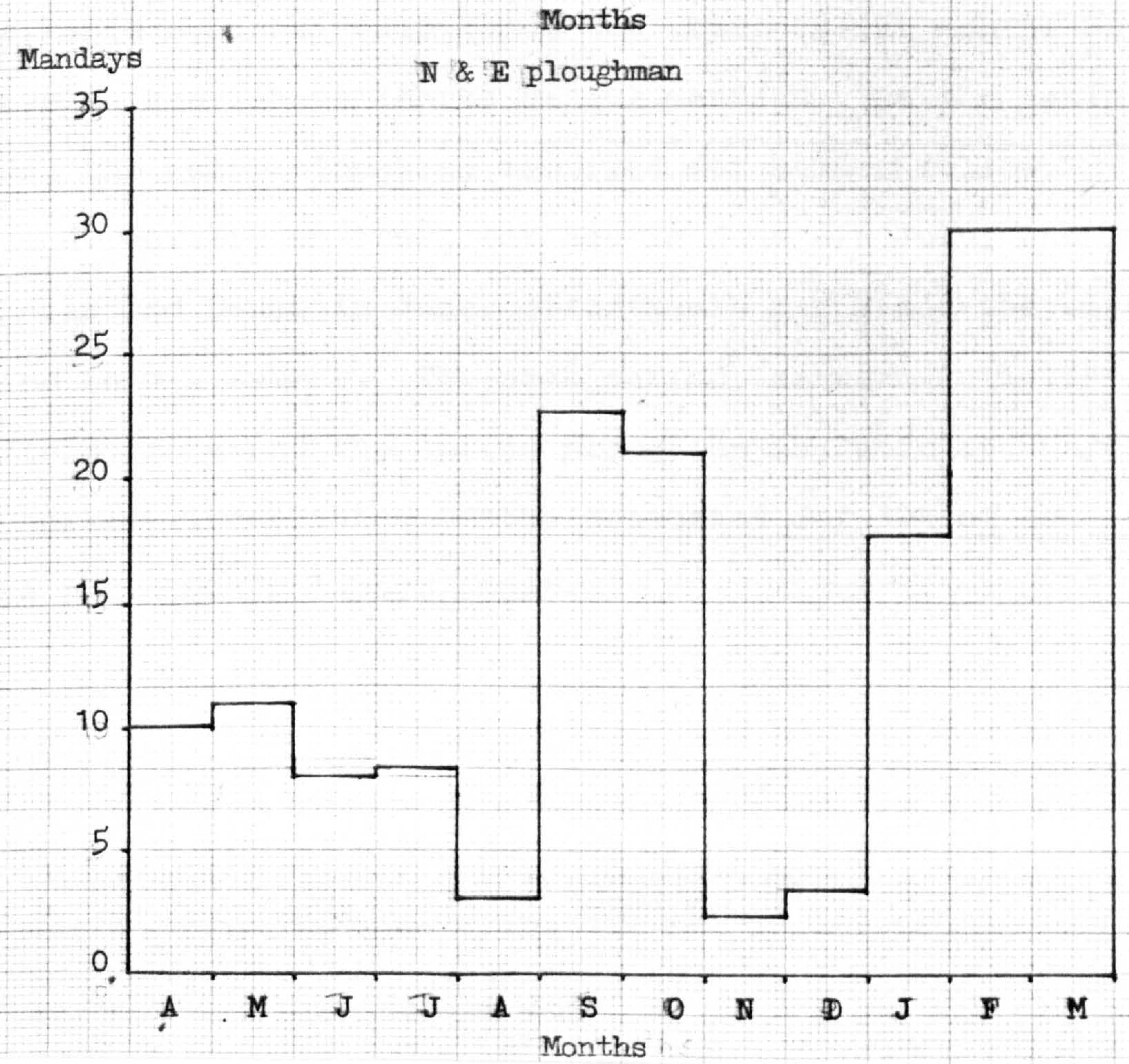
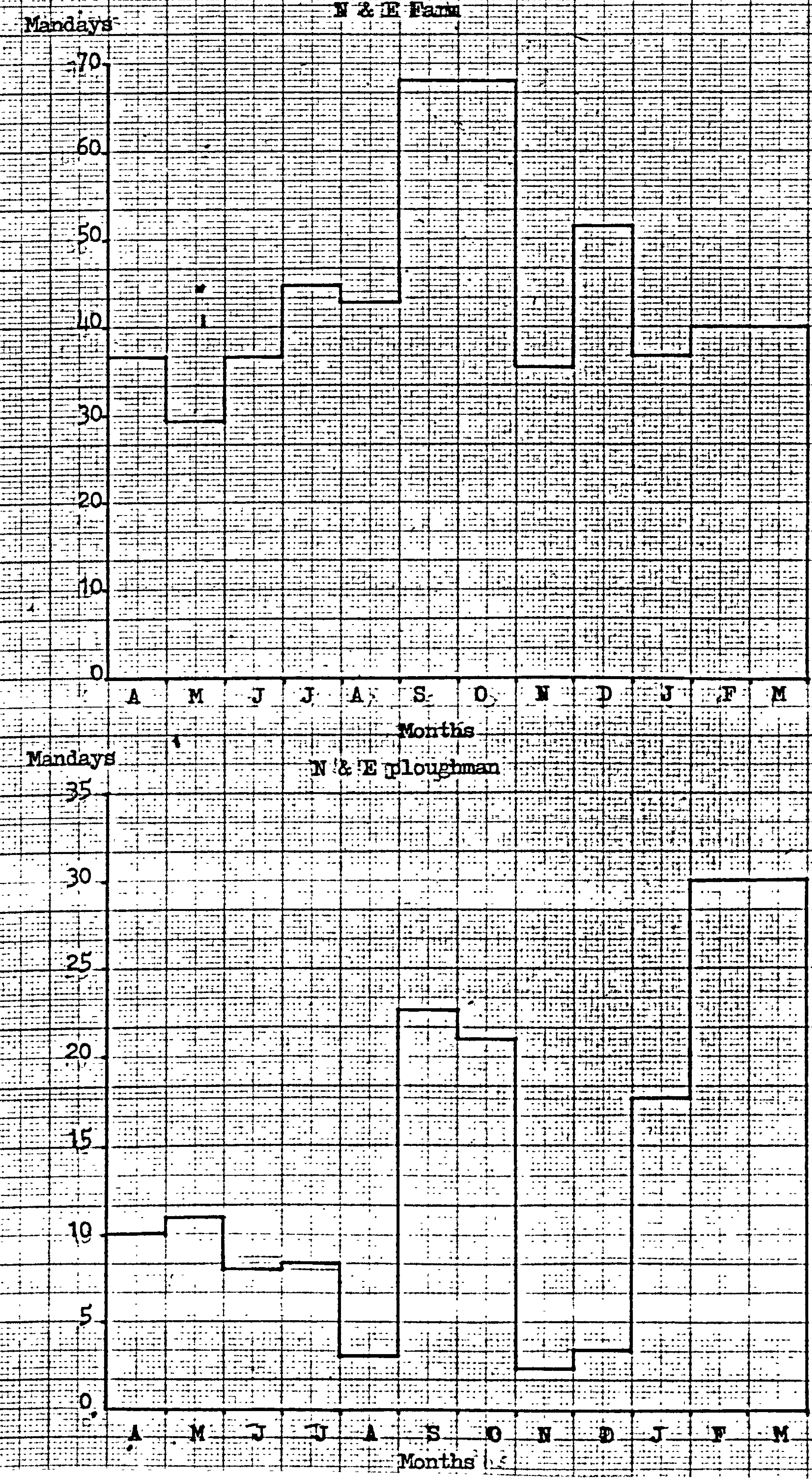


Figure 3.5

Seasonal distribution of crop labour requirements, N & E Bengal,

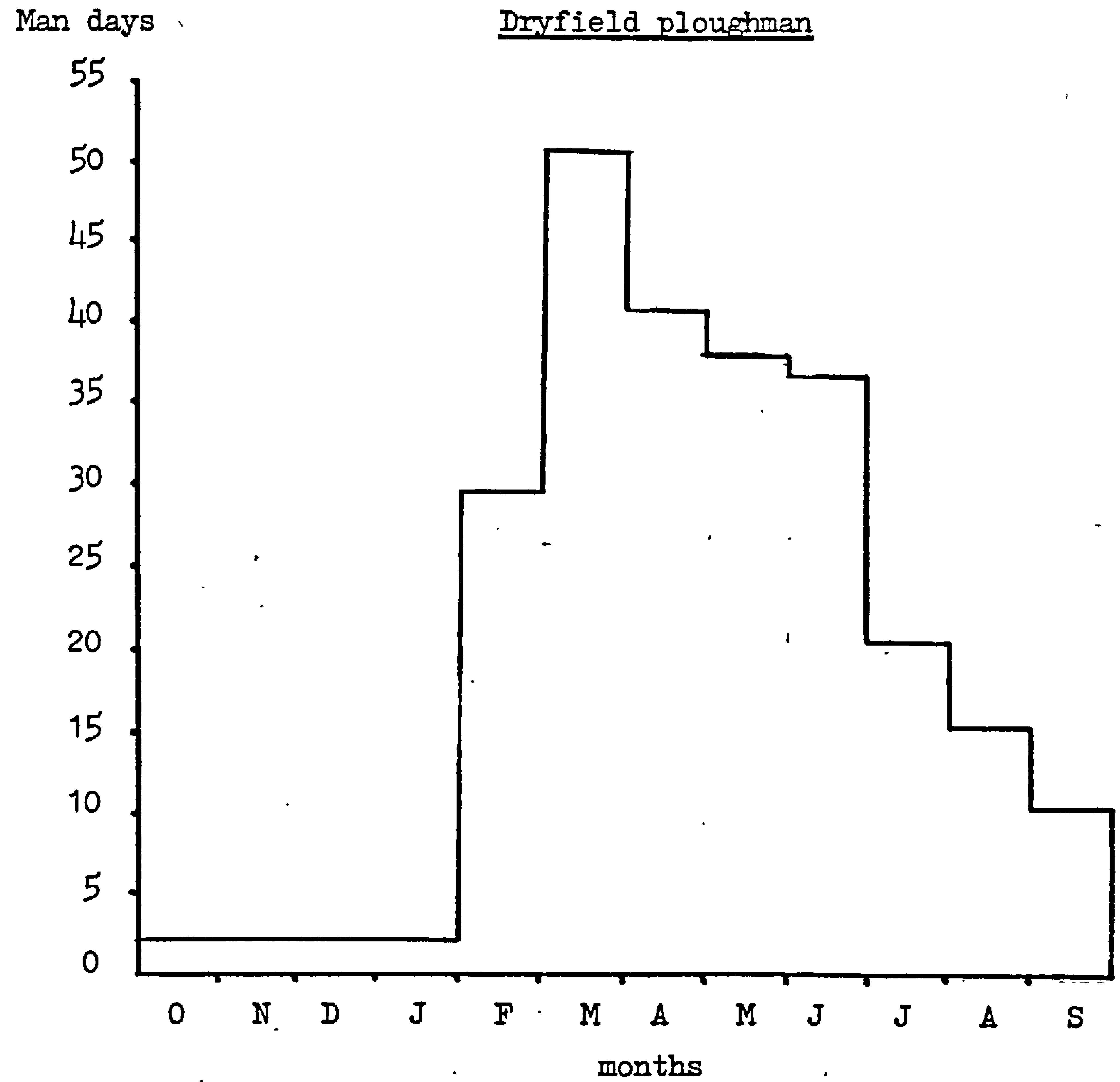


The Forth Valley presents a different picture (Figs. 3-6 and 3-7). The seasonal unemployment produced by the winter standstill is immediately obvious, particularly on the dry field. Whereas in Bengal the four months October-January take 36% of total farm labour, the same months in the Forth Valley take only 6% of dryfield farm labour. By contrast, harvesting (July-September) claimed 37% of total labour input in the carse and 50% in the dryfield. Seasonal unemployment was, therefore, greater in the Forth Valley then in Bengal.

When we compare the seasonal distribution of animal labour, the contrast is reversed. Take farming in the carse. The ploughman was employed for roughly 260 days in the year. As the histogram shows, this was spread with remarkable evenness throughout the year: seven months out of twelve had labour inputs of 20> mandays. As the table shows, the heavy ploughing required for summer fallow through February to June, for hay in June and July, and for peas and beans in June, effectively minimised the slack period in mid-summer. The peak period, as with infield-outfield, remained the spring ploughing in February, March and April. These three months accounted for 30% of the carse ploughman's labour input.

Figure 3.6

Seasonal distribution of crop labour requirements, Forth Valley



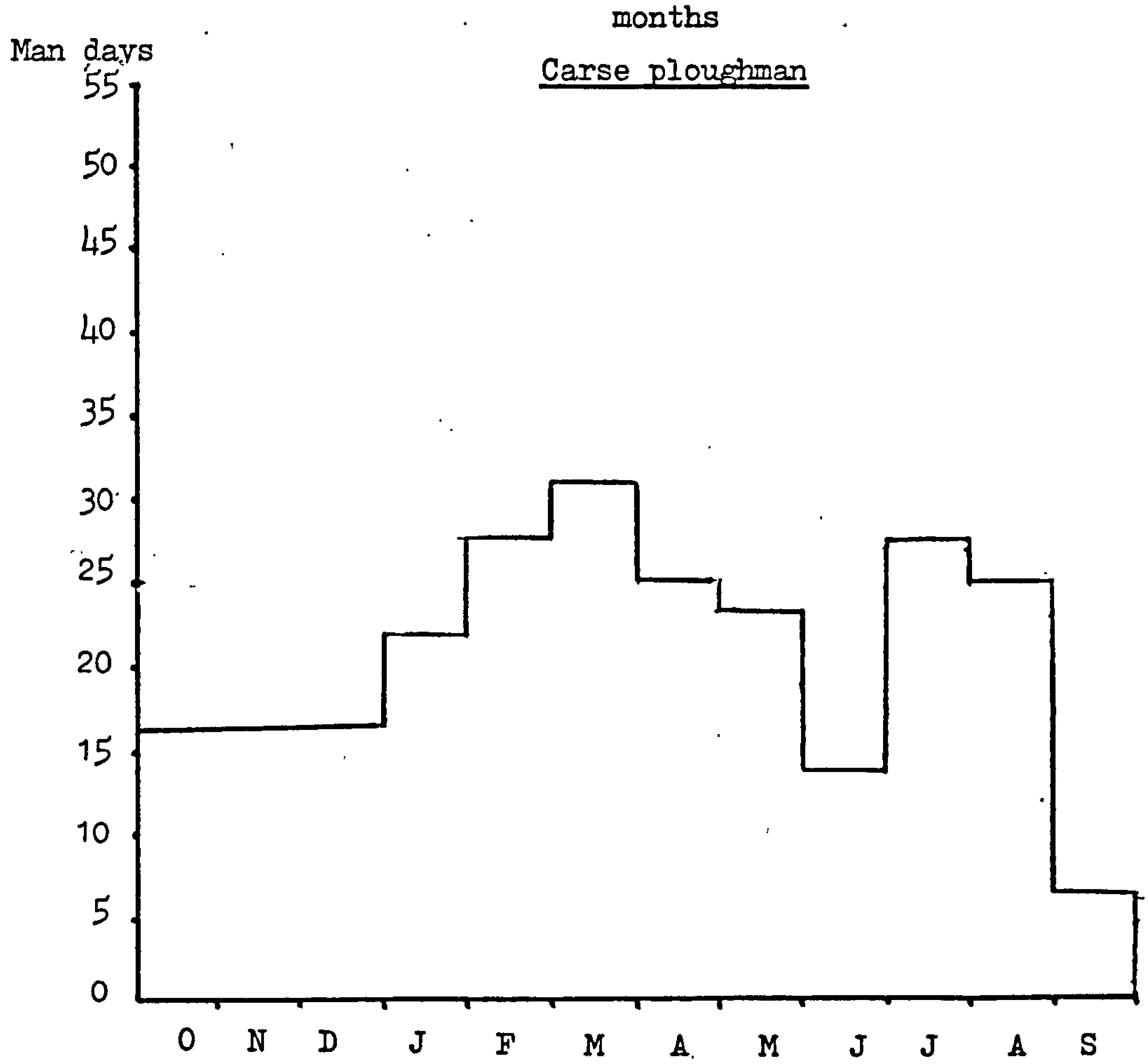
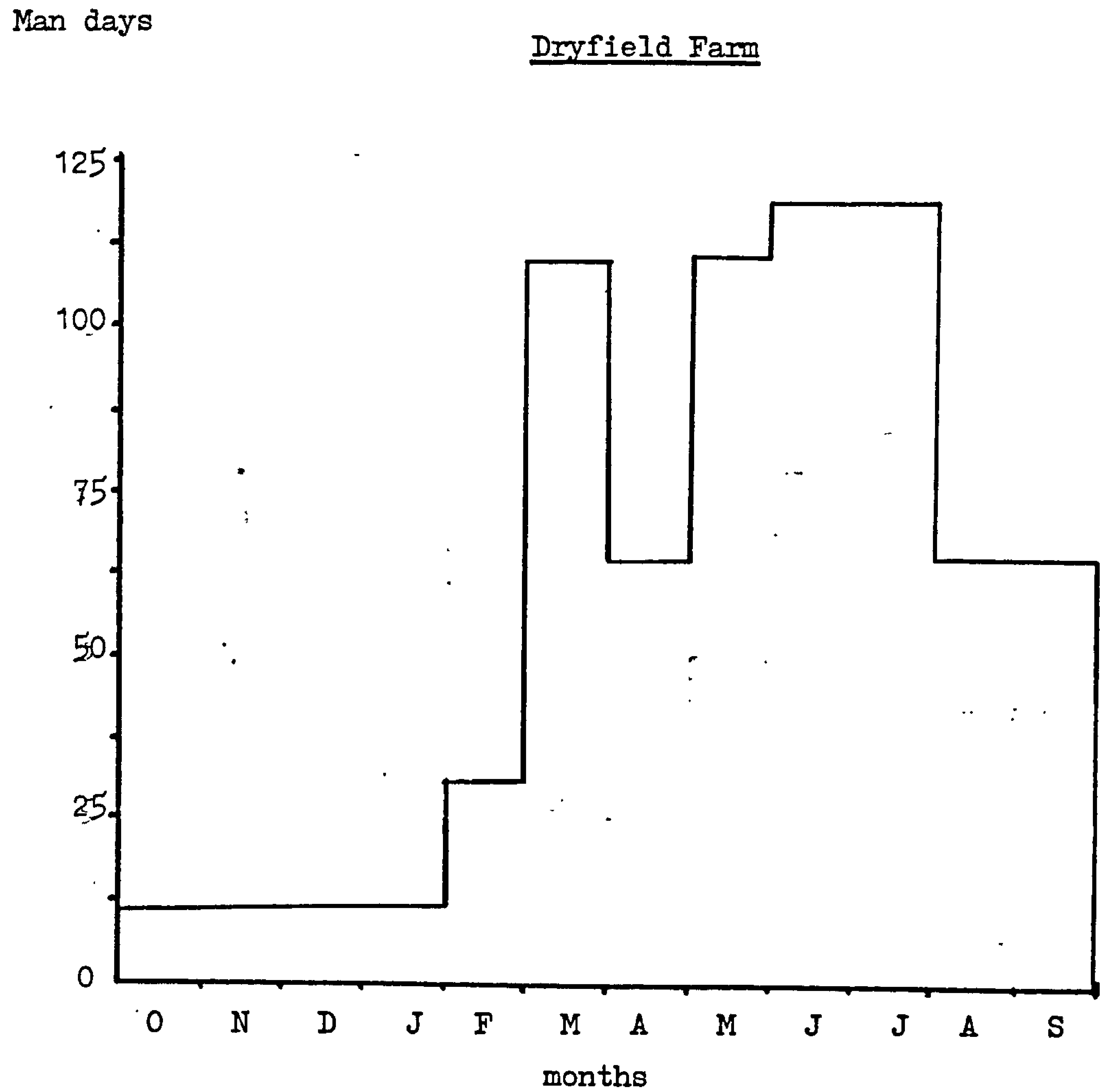
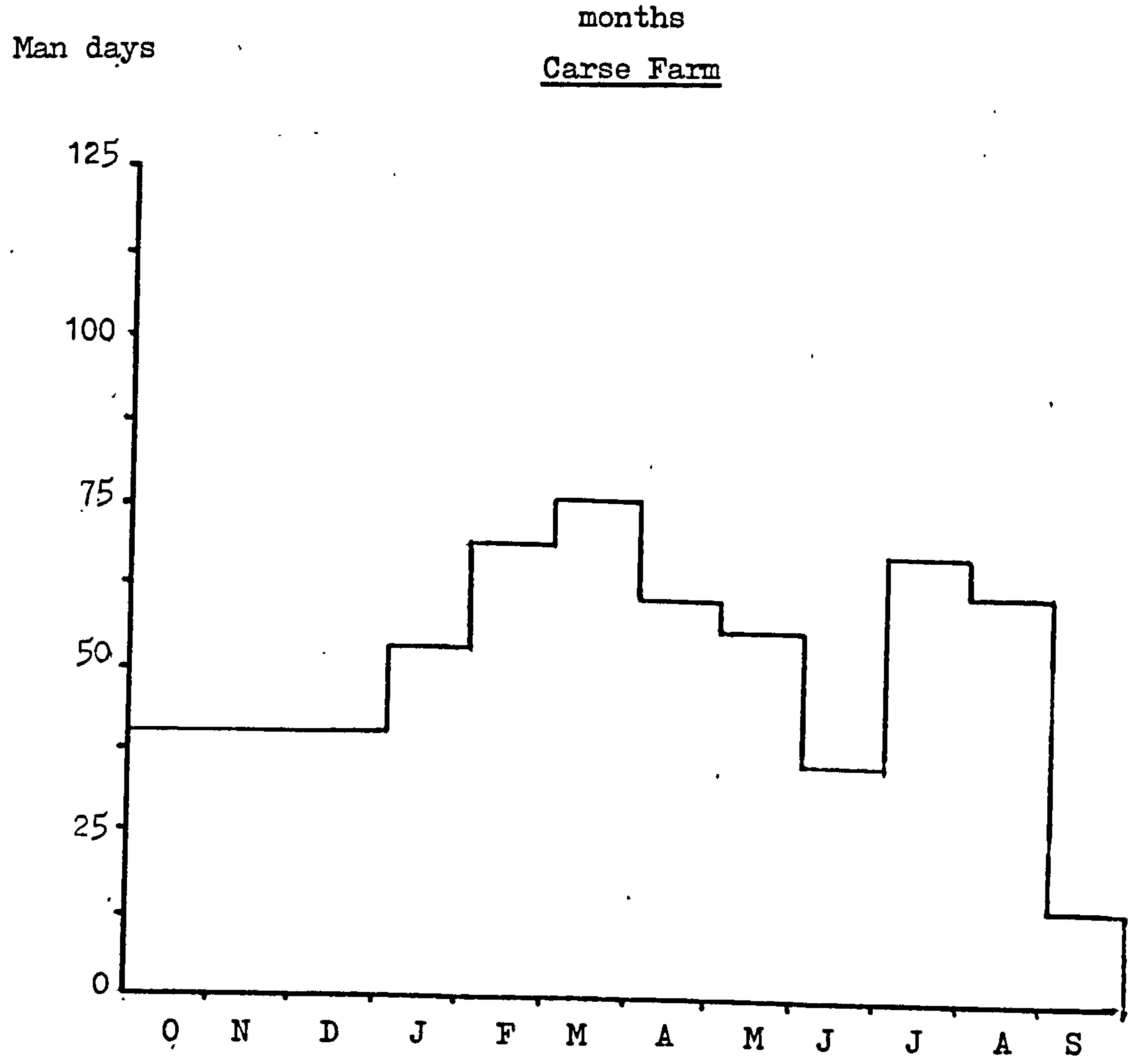


Figure 3.7

Seasonal distribution of crop labour requirements, Forth Valley





Ploughing in the dryfield followed a similar pattern. Again the ploughman worked for approximately 260 days in the year, but his labour was not nearly so evenly distributed in the carse. The histogram shows a peak period between spring and realy summer (February-June) and the table shows this accounts for over 65% of the ploughman's total labour input (See Appendix E). A more realistic model would introduce several modifications. Working days were longer in spring; cultivation practives may have been altered. The fact remains that "The ploughmen... know no rest for at least twelve hours every day, from the time the harrows are yoked for the spring wheat until the turnips are sown"[64].

The peaks in the seasonal distribution of plough labour in Bengal were much sharper. February and March had the most marked seasonal peaks, when the Norwesters permitted ploughing to begin. In N & E Bengal, where the large acreage under jute required intensive ploughing, these two months alone constituted 35% of all animal labour. The second peak in September and October was almost as important: they accounted for between 20-27% of all the ploughing in Bengal. This was the period of preparation for the staple cereal, aman rice. Conversely, the months of August, November and December were slack. In absolute

64. Stephens, Book of the Farm, vol. 1, p. 519.

terms, the maximum labour requirement of 191 days in N & E Bengal was considerably less than the 240 days adopted in Section I as the criterion for full employment. Employing a permanent staff of skilled ploughmen therefore offered little scope for reducing unit labour costs. It was the opposite in the Forth Valley, where ploughmen were fully employed throughout the year.

Despite the success of Scottish farmers in reducing seasonal underwmployment among their ploughmen, agriculture in the Forth Valley remained highly seasonal in terms of total labour requirements. One of the effects of the spread of finer and early-ripening varieties in the Forth Valley was a shortened harvest-period. "All our corn crops come to maturity at present nearly at the same time..." wrote one farming correspondent[65]. Bear's short photoperiod had meant that "the barley harvest was always finished before the cutting of oats commenced"[66]. Barley's longer photoperiod meant that its harvest now overlapped. Similarly, oats also ripened earlier. "Potato oats, in general cases, are ready for the sickle much about the same time as winter wheat... "Not so the case formerly. The Poland and Friesland oats were ready for cutting eight or ten days before wheat...". This telescoping of the photoperiods had unforseen consequences. "It does happen that the crops of a

65. D. C. "On the use and advantages of a reaping machine", Quarterly Journal of Agriculture, vol. 1 (1828-29), No. XXI.

66. Leslie, General View of Moray and Nairn, p. 171.

whole farm require to be cut down in a few days, and that very serious damage may be incurred by delay. Potato oats are easily shaken, and require to be cut down before they arrive at full maturity; wheat soon sprouts, and barley is soon discoloured when exposed to moisture". Farmers watched nervously as the effects were felt on the labour market. "A shortened harvest period, warned one,"threatens to occasion a constant deficiency of harvest people and high wages"[67]. The change in seasonality which accompanied the agricultural revolution may have weakened employers' position in the labour market, at least during the harvest.

In Bengal, the labour market had two peaks, in the _aus_ harvest in August-September and in the _aman_ harvest in November and December. There were also two slack periods. The first came after the weeding of _aus_ and jute in April and before the _aus_ harvest; the second came after the _aus_ harvest and before the _aman_ was cut. A third slack period followed the _aman_ harvest and lasted until the _aus_ and jute weeding began again in April, Seasonal unemployment among wage labourers was highest in the third period. "Vegetable crops and the _boro_ (winter) rice crop, which are harvested during that period, do not create much employment, and land for _aus_ and jute is usually prepared and sown by family labour"[68]. In Burdwan, the gradual decline in the _rabi_

67. _Farmers Magazine_, vol. 7, (1806). Agricultural Intelligence. Scotland. East Lothian Quarterly Report, p. 541.

68. Cain, "Class, Patriarchy, and Womens' Work," p. 421.

sown area would have made the problem still more acute. But not all social groups were equally affected. "A cultivator with a holding of his own can find something to do about the farm, such as feeding his animals, cleaning a tank or carting his saleable crops to the merchant or the rice mill... The landless i.e., farmless "labourers", on the other hand, are practically idle"[69]. The dry season was not a season of unemployment among cultivators. The aman rice harvest had to be thrashed and processed, and this was done with family labour. Despite the fact that as much as 80% of the land might lie fallow, farmers had little incentive to cultivate it. Besides the cost of irrigation, the timely fixed photoperiod of aman prevented its growth during the dry season, thus reducing the area which could grow rice and the profits for doing so.

Overall, seasonality in Bengal compares well with the Forth Valley in terms of the distribution of total farm employment. Despite a variable rainfall which meant ploughing had to be compressed into relatively short periods, Bengal had the advantage of a growing season which extended throughout the year and permitted three separate harvests. This ensured a regular distribution of seasonal labour throughout the year. For all the ingenuity of Scottish farmers, they could not vanquish the winter. It cannot therefore be said that the variable monsoon proved an

69. Geddes, Human Geography of Bengal, vol. 1, E2.

obstacle to the development of capitalist agriculture in Bengal.

Section 3: surplus labour

We can now proceed to measure surplus labour. The available labour supply in the Forth Valley, according to the criteria established in section I, is given in the table below. The seven parishes together equal a 20% sample, large enough for firm generalisations.

Table 3.1

LABOUR-DAYS AVAILABLE (LA) FORTH VALLEY, 1831

PARISH	260 DAYS/YEAR NORM	288 DAYS/YEAR NORM
Baldernock	22620	25056
Denny	46020	50976
Killearn	32760	36288
Kilsyth	47580	52704
Logie	56420	62496
Polmont	45760	50688
Strathblane	27040	29952

Source: Parliamentary Papers, 1833, vol. XXXVII, Population of Great Britain, vol. II, Stirlingshire and Perthshire.

Note: Labour supply defined as total categories (a) occupiers employing labourers (b) occupiers not employing labourers (c) labourers employed in agriculture.

The size of the agricultural labour force in Bengal is derived from the occupational data collected for the 1911 Census. The Census drew up a list of 169 occupational groups. These were divided into four main classes. Class A, Production of Raw Materials, with which alone we are concerned, included two subclasses of which only the first, Exploitation of the surface of the earth, is relevant. Under this category, occupations were further divided into two sub-orders, pasture and agriculture, and fishing and hunting. The sub-order pasture and agriculture under the heading "ordinary cultivators" listed the following occupational groups:

I. Income from rent of agricultural land
II. Ordinary cultivators
III. Agents, managers of landed estates
IV. Farm servants and field labourers

In estimating the labour force only groups I, II and IV were counted. Those employed in growing specialist crops (eg. tea) were enumerated separately and have been excluded. Similarly all those listed as "partially agriculturalist" or following agriculture as a subsidiary occupation were excluded, since their share of total labour input is unknown. Some attempt was made to allow for subsidiary occupations by including "labourers and workmen otherwise unspecified" (group 167) with field labourers. Dependents were included by isolating males (51.405% of total population) and using the provincial age-distribution to calculate the number of male dependents between 10-15

(29.134% of total male population). These were then classed as male working dependents, two of whom were equivalent to one adult worker. Actual, as distinct from potential workers, were calculated by omitting group I above, and their male working dependents. The results are shown in table 3.2.

Table 3.2

LABOUR-DAYS AVAILABLE (LA) & POTENTIAL LABOUR-DAYS (LW), BENGAL 1911

(million mandays)

CATEGORY	240 DAYS/YEAR NORM		260 DAYS/YEAR NORM	
	S & W	N & E	S & W	N & E
POTENTIAL WORKERS	7985863	6283931	7985863	6283931
POTENTIAL LABOUR-DAYS	1916.60	1508.14	2076.32	1633.82
ACTUAL WORKERS	6594081	6157721	6594081	6157721
LABOUR-DAYS AVAILABLE	1582.57	1477.85	1714.46	1601.00

Source: Census of India, 1911, vol. V, Bengal Part II, III, Table XV, Occupation or Means of Livlihood (Calcutta, 1913).

Data on labour utilisation for both regions was derived from crop statistics. For the Forth Valley, the acreage under various crops in seven parishes is available for the period 1836-1841. Unfortunately these are incomplete, with the fallow acreage given in only two cases. Nevertheless, they are the only statistics available for this period and they are consistent with the 1831 census data on agricultural labour supply.

Table 3.3

LAND USE IN SAMPLE FORTH VALLEY PARISHES, 1841
(acres)

PARISH	WHEAT	OATS	BARLEY	PEAS/BEANS	HAY	POTATOES	TURNIPS	FAL
Baldernock	183	584	45	21	335	170	42	20
Denny	136.97	2193.02	361.86	58.18	152.77	-	-	
Killearn	60	1500	360	200	600	200	-	
Kilsyth	30	1059	156.5	-	502.25	248	130.75	
Logie	500	625	625	500	625	163	62.	400
Polmont	450	700	450	300	450	160	80	
Strathblane	60	550	140	8	410	139	40	

Source: NSA, vol 8,

Data for Bengal shows the acreage under the seven major crops (rice, wheat, gram, oilseeds, jute, sugar, tobacco) in 1911-12.

Table 3.4

LAND USE IN BENGAL, 1911-12
(000 acres)

Region	Rice	Wheat	Pulses	Oilseeds	Jute	Sugar	Tobacco
S & W	13678	675	993	5445	413	1125	48
N & E	9951	735	878	14475	22175	125	271.5
Bengal	23629	141	1871	1992	26305	2735	319.5

Source: K. L. Datta, Report on the Enquiry into the Rise in Prices in India, (Calcutta, 1914), vol. 3, pp. 298-305.

Both sets of Figures were then brought together to provide an aggregate estimate of surplus labour. The results for the Forth Valley are shown in table 3.5.

Table 3.5

SURPLUS LABOUR IN THE FORTH VALLEY, 1841
(Mandays)

PARISH	(1)	(2)	(3)
Baldernock	23961.16	-5.92	+4.37
Denny	39604.85	+13.94	+22.31
Killearn	43858.6	-33.97	-20.86
Kilsyth	34480.84	+27.54	+34.58
Logie	57670.23	+2.17	+7.73
Polmont	45197.20	+1.23	+10.88
Strathblane	21741.62	+19.60	+27.42

Sources : Tables 3.3 and 2.31.

Notes: (1) Labour utilisation (lU).

(2) Labour supply as proportion of labour utilisation with 260 days as duration of working year.

(3) Labour supply as proportion of labour utilisation with 280 days as working year.

The percentage figures show labour supply as a proportion of the total labour utilisation. Several anomolous cases may be discounted. Killearn parish, for example, shows a labour shortage of 20%, even when the duration of the working year is at a maximum (line 3). This is best explained by imperfect occupational specialisation, which makes census data an unrealiable guide to labour supply where there is a large manufacturing population. Killearn had such a population, many of whom would be employed in agriculture during peak-periods. "In all the seasons when additional hands are required, such as seed-time, hay making, hand hoeing, and in corn harvest, the many well-peopled manufacturing villages turn out numbers of inhabitants, who execute the farmers work at a moderate rate", noted one Stirlingshire observer[70]. Similarly, the figure for Kilsyth parish shows that, given 288 days as the normal length of the working year, only 65% of the population was fully employed. This probably exaggerates the real extent of unemployment, since it is likely that some found employment in neighbouring parishes. Discounting these two cases, the average labour utilisation in the remaining five parishes is between 85-93%, depending on which duration of the working year we choose. Given the approximate nature of the statistics, this represents an extremely high rate of labour utilisation. At most, the labour surplus was 15%. There therefore seems little evidence of surplus agricultural population in the Forth Valley by 1840.

The results for Bengal show a different picture. The totals were calculated separately for both S & W and

70. Belsches, General View Stirling, pp. 61-62.

N & E Bengal, the former corresponding to the rice and the latter to the jute producing areas of Bengal. The percentage figures again show labour utilisation as a proportion of the total labour supply.

Table 3.6

SURPLUS LABOUR IN BENGAL, 1911
(million mandays)

	240 days year norm				260 days year norm			
Category	S & W	%	N & E	%	S & W	%	N & E	%
LU	1476		1469		1476		1469	
LW	1582	+7.18	1477	+0.54	1714	+16.12	1601	+8.98
LA	1916	+29.81	1508	+2.65	2076	+40.65	1633	+11.16

Source: Tables 3.4 and 2.31.
Notes: LU = Labour days used
LW = Labour days available
LA = Potential labour days.

The results show that neither area of Bengal was characterised by an enormous labour surplus. Even with a working year of 260 days the labour requirement correspond closely with the number of actual workers. Thus, in S & W Bengal there is a labour surplus of 15%, while in N & E Bengal the surplus is only 8%. This matches our earlier estimate of 15% for the Forth Valley.

Naturally, the statistical base is not immune from criticism. Periodic census data in Bengal suffers from the same limitations observed in Scotland of imperfect occupational specialisation. In addition, the separation of the actual from the potential labour supply poses special problems, since many who received income from land were themselves rent-payers. "The small agriculturalist is frequently a cultivating and non-cultivating land-owner, a tenant, a farm servant and a field labourer, all rolled into one, owning land which he partly cultivates and partly lets out for rent, hiring other land from someone else, and eking out his earnings by working on the land of others"[71]. Most importantly, however, the census fails to record seasonal immigration. The census date was 10th March, whereas most immigration to Bengal came in August and September for the jute harvest. "The well-to-do Bengali cultivators depend largely on the annual influx of labourers from Bihar and Orissa for reaping their crops and complaints are frequent of the inadequacy of local labour"[72]. Retting and stripping jute were tasks which required skill and were usually performed by seasonal workers (See Table 7.8 above),

71. Census of India, 1901, vol. 1., Pt. 1. p. 205.

72. Census of India, 1911, vol. V., Pt. 1, Report. Bengal, Bihar and Orissa and Sikkim, p. 536.

Consequently, our estimates of labour surplus in Bengal cannot pretend to complete accuracy. Nevertheless, there are good reasons why we should expect to find little labour surplus in Bengal. The expansion in the acreage under jute was so dramatic that by 1914 the jute crop accounted for over 20% of the total labour input in N & E Bengal. Inevitably, such a rapid expansion created acute labour shortages in peak-periods. Jute was most commonly grown in rotation with t. aman, replacing the old double-rice rotation of aus/aman. Figure 3.8 shows the seasonal distribution of labour for each rotation. Jute sharply increased the demand for labour from August onwards, particularly during the months when aman was being transplanted. Hence commercial agriculture's dependence on cheap labour from Bihar for retting and stripping jute after the harvest in June. Even in the rice growing S & W, the picture is much the same. There was no reserve army of underemployed labour which could be mobilised at a constant real wage to provide an unlimited supply of labour for the manufacturing sector.

This is consistent with other attempts to measure surplus labour in Indian agriculture using historical data. Schultz tested the hypothesis of surplus labour by determining whether or not productivity fell after the influenza

Figure 3.8

Seasonal distribution of Labour with jute/T aman and aus/aman rotation

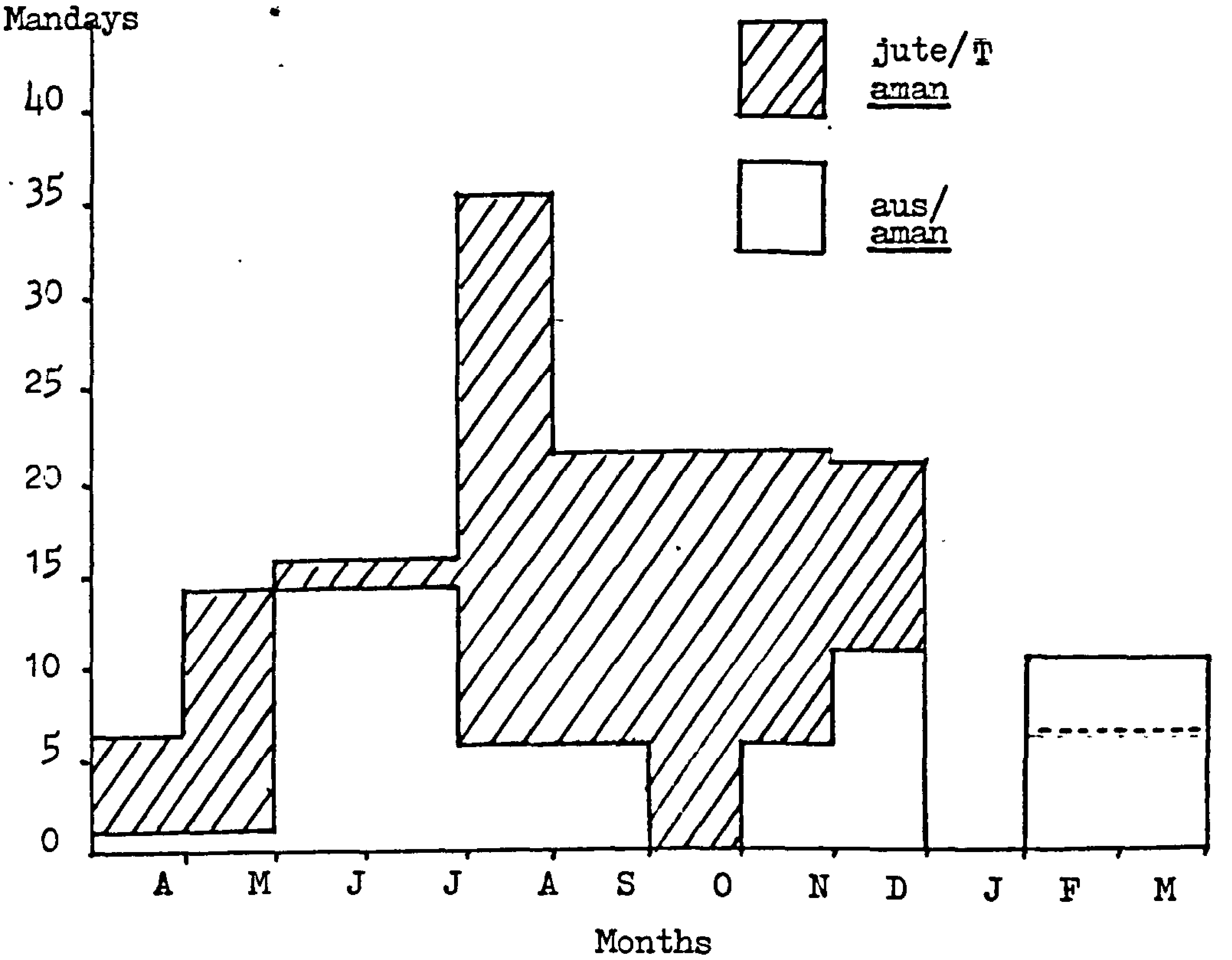
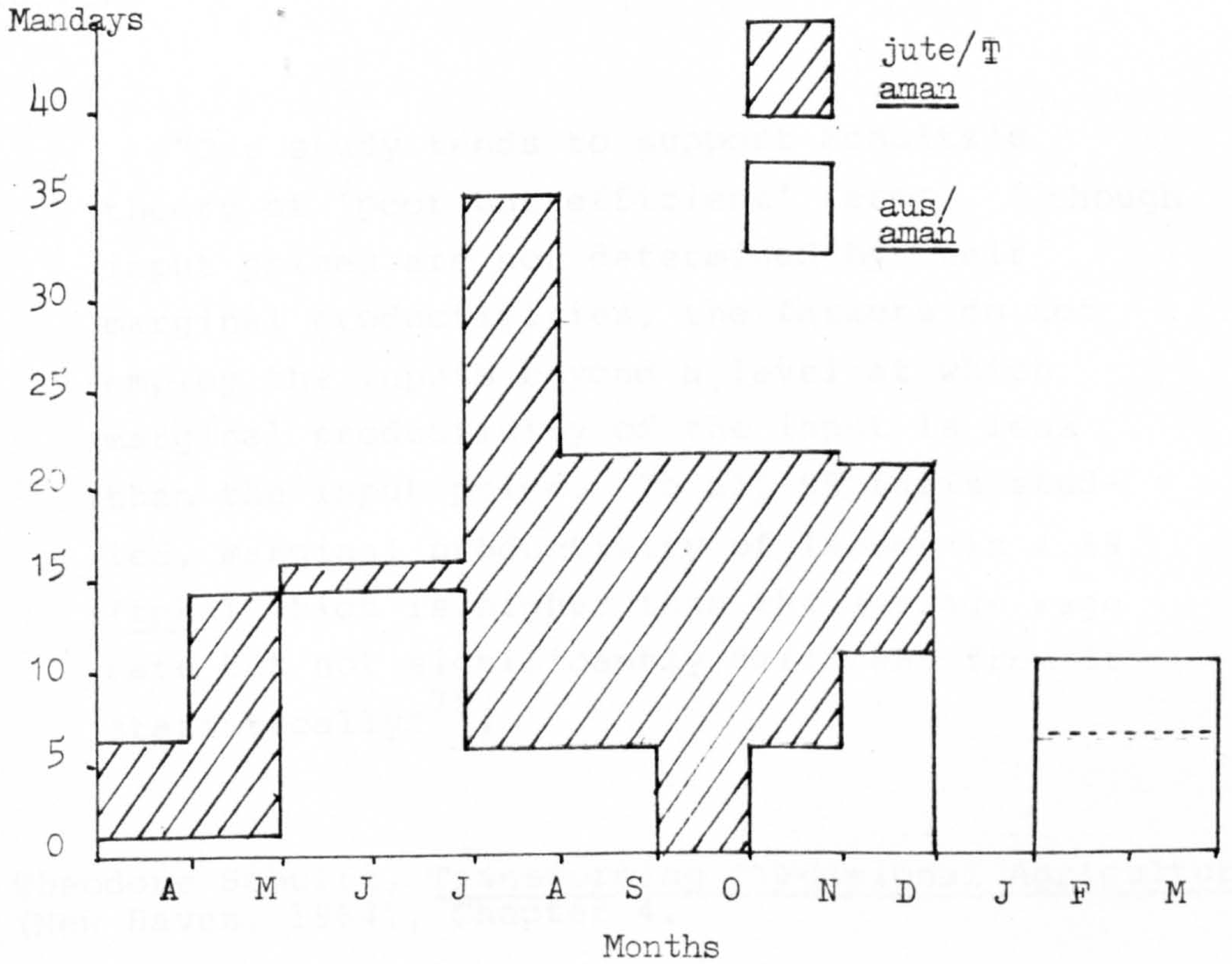


Figure 3.8

Seasonal distribution of Labour with jute/T aman and aus/aman rotation



epidemic of 1918[74]. The answer was positive. Schultz estimated that the marginal productivity of labour in Indian agriculture was 0.4 (i.e., a 1% increase in labour input increased agricultural output by 0.4%). Other studies of traditional agriculture have confirmed Schultz's conclusion:

> "Our study tends to support Schultz's theory of 'poor but efficient' farms. Although input prices are not determined by their marginal productivities, the farmers do not employ the inputs beyond a level at which marginal productivity of the input is less than the input price. In all 95 farms studied, marginal productivity of labour is 4.59 (taka) which is higher than the average wage rate but not significantly different from it statistically"[75].

74. Theodore Schultz, Transforming Traditional Agriculture, (New Haven, 1964), Chapter 4.

75. Mahabub Hossein, "Farm Size, Tenancy and Land Productivity: An Analysis of Farm Level Data in Bangladesh Agriculture". The Bangladesh Development Studies, vol. V, No. 3, (July, 1977), p. 490. For other studies in this region which confirm Schultz's conclusions, see Warren C. Robinson, "Disguised Unemployment Once Again: East Pakistan, 1954-61". American Journal of Agricultural Economics, vol. 51, No. 3, (1969), p. 593; and SS Pal, "Productivity of Farm Labour in the Context of Rural Unemployment", Economic Affairs, vol. 18, Part 5, (1973), p. 244.

But Schultz's method is open to criticism[76]. By defining surplus labour as <u>any</u> proportion of the labour force which can be removed without reducing agricultural output, he ignores the vital distinction between actual and potential workers. Potential workers include those whose caste or social status renders them voluntarily un- or under-employed. Brahmins, for example, are forbidden to hold the plough while marginal farmers may be unwilling to supplement their income by working as field labourers.

It is clear from our figures that most surplus labour in Bengal was of this kind. By using the criterion of "potential labour days" with a working year of 260 days, the proportion of surplus labour in S & W Bengal was 30%. By contrast, it was only 10% in the jute producing area of N & E Bengal, further evidence of the employment created by the spread of commerical crops. Yet, most of this under-employment must have been voluntary. Caste taboos barred many farmers from holding the plough, even when it was in their economic interest to do so. Moreover, social status was incompatible with manual labour. As cultivators' real incomes grew with the rise in agricultural prices, more and more joined the ranks of the voluntarily unemployed. As one

76. A. K. Sen, "Surplus Labour in India - a critique of Schultz's statistical test". <u>Economic Journal</u>, vol. 77, (1967), pp. 154-161; <u>Schultz's reply</u>, pp. 161-163 and Sen's rejoinder, pp. 163-5.

observer noted, "a significant facet of the modern progressive tendency is seen in the inclination of the raiyats to abstain from manual labour and keep hired servants as soon as their means allow them to do so". Social considerations of this kind explain much of the apparent labour "surplus" in traditional agriculture[77].

Such behaviour may explain the absence of change in the labour input to Bengal agriculture between 1890-1914.

Table 3.6

LABOUR INPUTS, BENGAL 1890-1914
(million mandays)

	1890	1914	%
S & W	1445.74	1476.75	+2.14
N & E	1489.85	1469.00	-1.39
TOTAL	2935.59	2945.75	+0.34

Source: Appendix.

Table3.6 shows that between 1890-1914 labour inputs to Bengal agriculture stayed constant. This might seem unsurprising since the total cultivated area was also

77. Most surplus labour in modern Bangladesh is voluntary. A case study of Shahbazpur Union shows that given a working year of 240 days, 35.70% of the labour force was surplus: of this, the greatest component was voluntary unemployment, (22.67%). Involuntary unemployment accounted for only 4.95%. Ahmed, "Unemployment and underemployment", pp. 1288-1289.

constant during this period. But population grew by 13%. Moreover, new labour-intensive crops like jute were introduced. But whereas labour inputs in the S & W rose between 1890-1914 in the NE, the region of fastest population growth and of jute production, they actually fell. Hence although jute was highly labour-intensive an increase in the area under jute was offset by a decrease in the area under pulses, sugar and tobacco.

Comparisons of surplus labour are difficult because no single definition is possible. Social and cultural factors override economics and determine the participation rate, the length of the working year and the number of actual as opposed to potential workers. Such factors were all too evident in 19th century descriptions of the Bengal peasantry:

> "They get their living too easily; there is not a country on the face of the globe where life is so easy, so void of oppression, sustained with so little labour, or suffering or anxiety. Look at the English labourer. He is up before dawn; in the dark night of the winter he is at his work often before he can well see, in cold and frost, and rain and this not for one day or two days, but day after day, and year after year, and he is well satisfied, if after all he can keep himself and

> his family in food and clothes and fire; and he does do it; and the thrifty ones can turn out respectably on Sundays or holidays, - when their clothes alone are worth more than half the year's earnings of the lazy ryot"[78].

The relish with which middle-class observers described the industry of the agricultural labour force in Britain emphasises the difference between the two agrarian systems. Differences in labour productivity were related to different relations of production. By 1840, most of the agricultural labour force in the Forth Valley consisted of landless labourers. Unlike their counterparts in Bengal, or even England, the majority were hired by contracts either for a year or six months, and lived on the farms on which they worked. Their semi-permanent status enabled employers to impose an almost factory-type discipline. In 1807, for example, Justices of the Peace in Kelso declared that "it was a mistake in servants, hired by the year or half year, to suppose that, after their ordinary work hours, they are at liberty to dispose of or absent themselves as they please without their master's leave"[79]. Moreover, because the labourers were resident, their wives and children provided a ready supply

78. Anon, "Act X of 1859". Calcutta Review, vol. XL, (1864), Art. X., pp. 294-295.

79. Paul R. Docherty, The Condition of the Rural Labourer in East Lothian, 1780-1840, (B.A. dissertation, Strathclyde, 1976, Economic History), p. 42.

of cheap labour during peak periods. Seasonal unemployment was thus kept to the minimum.

The device of the annual contract prevented surplus labour in another way, by ruling out the possibility of work-sharing which existed when labour was hired on a daily basis. Men who could not find work simply had to leave. After 1815, when there was widespread unemployment, emigration became increasingly common. Between 1801-1841, the national rate of population growth per annum in Scotland was 1.228%. Any area with a substantially smaller increase must have been experiencing net out-migration. In the Forth Valley, this affected 23 out of a total of 36 parishes. Enclosure is usually singled out as the major "push" factor behind emigration, but we have already shown that labour inputs after enclosure were greater or equal to those before. The relevant factors seem more likely to have been bigger farms, legal uncertainty about the right of able-bodied labourers to poor relief, and the ubiquitous hiring system[80]. Labour productivity in Scottish agriculture was, therefore, much higher than in Bengal, but at a price in social terms. William Cobbett wrote bitterly of the Lothians in 1832: "Everything is abundant here but people, who have been

80. Tom Devine, "Social stability and agrarian change in the eastern lowlands of Scotland, 1810-1840", Social History, vol. 3, (1978), pp. 342-344.

studiously swept from the land"[81].

By contrast, Bengal agriculture was characterised by a significant number of potential workers who contributed little to production. This had important implications for development.

> Under these conditions, there was no incentive for groups of individual farmers or small enterprises to make marginal and unrelated investments of capital in the labour-intensive sector, even if they had the capital to invest. Nor had they any reason to introduce labour-saving innovations, even if they knew about them and could finance them. And, as yet, there is no technology designed to raise output per worker without also raising the ratio of capital to labour. Labour as a group, had no incentive to increase its efforts, since the labour supply was already redundant[82].

But while labour as a group may have had no incentive to increase output, landlords evidently did have such an incentive. In the Forth Valley, landlords raised

81. Quoted Docherty, op. cit., p. 29.

82. Benjamin Higgins, Economic Development, (New York, 1968, rev. edn.), pp. 302-303, emphasis in original.

output by massive capital investment in innovations like enclosure which improved land productivity. Why were landlords in Bengal unable or unwilling to undertake such investments? Did the low rate of capital formation in Bengal agriculture reflect the absence of economic incentives, or were institutional and even cultural factors responsible? These are important questions which deserve separate treatment.

CONCLUSION

The extent of surplus labour in both agricultures was measured indirectly by comparing labour utilisation with labour supply. The results showed that the number of actual workers closely matched labour requirements. The excess in both cases was only about 15%. This apparent surplus can be explained by the seasonal nature of agricultural employment. When allowance is made for labour demand at peak periods, all actual workers are found to be fully employed. However, when the labour force in Bengal is expanded to include potential workers, then a large proportion of the agricultural population is shown to be surplus to production. In S & W Bengal, this proportion was as high as 30%, whereas in N & E Bengal the spread of new commercial crops like jute meant that labour demand outstripped supply. Most of the underemployment in Bengal was voluntary, however. It did not consitute an unlimited supply of labour available for employment outside the agricultural sector. For this labour to become productive, there had first to be a change in the social and cultural attitudes of the landowning elite, and in particular, their use of capital.

CHAPTER FOUR

Capital

Capital is the third input in our production function. Theoretical studies of economic growth commonly place capital formation and investment at the heart of their analyses. "The central problem in the theory of economic development is to understand the process by which a community which was previously saving 4 or 5 per cent of its national income or less, converts itself into an economy where voluntary saving is running at about 12 to 15 per cent of national income or more. This is the central problem because the central factor of economic development is rapid capital accumulation"[1]. The agricultural revolution in Scotland was the product of massive investment in innovations which transformed both productivity and the rural landscape. By comparison, it was the absence of similar investment in Bengal which kept agricultural productivity low. "In agriculture ... the want of capital is a bar to all improvement", wrote on early observer. "Supplied with it, larger farms would be occupied, greater enterprise, and better information would ensue; and thus

1. W.Arthur Lewis, "Economic Development with Unlimited Supplies of Labour", The Manchester School, vol. 22, No. 2, (May, 1954), p. 155.

the various obstacles to its success would be discovered and overcome"[2].

Several hypotheses have been advanced for the absence of capital investment in Bengal agriculture. Of these, none has proved more influential than the theory of the parasitic landlord. Essentially the argument is that although Bengal zamindars, like their Scottish counterparts, successfully extracted the economic surplus through high rents, they used the surplus unproductively in money-lending and conspicuous consumption. This theory has found favour with historians of very different ideological persuasions. For Barrington Moore, the parasitic landlord was primarily the result of India's own internal development ("this blight was inherent in India's own social structure and traditions")[3]. For Rajat Ray, on the other hand, parasitic landlordism was the response of the native elite to the economic demands of British imperialism. By rackrenting and usury, Bengal landlords forced the peasant producer to sell his crops immediately after harvest for low prices, since he needed cash urgently in order to pay his debts. This ensured a cheap source of raw materials for British

2. William Tennant, Indian Recreations, consisting chiefly of strictures on the domestic and rural economy of the Mahomedans and Hindoos. (London, 1804-8, 2nd edn.) vol. 1, pp. 19-20.

3. Barrington Moore, Jr., Social Origins of Dictatorship and Democracy. Lord and Peasant in the Making of the Modern World, (Penguin, 1973), p. 355.

export firms and a greater share of the economic surplus for the landlord[4].

In what follows, we challenge this interpretation of low agricultural productivity in Bengal. We do so by employing our comparison with the Forth Valley. Our comparison with Bengal focusses on three key aspects of the Scottish experience. The first is the structure of landholding; we try to assess how far the different nature of rights in land determined whether the economic surplus was used productively. Next, we compare the economics of the relations of production, and ask whether the decision-makers in Bengal agriculture were any less rational than their Scottish counterparts in their choice of tenancy or response to price incentives. Finally, the third section examines the process of capital formation by case studies of estates in the Forth Valley and in Bengal.

4. Rajat and Ratna Ray, "The Dynamics of Continuity in Rural Bengal under the British Imperium: A Study of Quasi-Stable Equilibrium in Underdeveloped Societies in a Changing World", Indian Economic and Social History Review, vol. X, No. 2, (June, 1973); pp. 103-128; Rajat K. Ray, "The Crisis of Bengal Agriculture, 1870-1927 - the Dynamics of Immobility", Indian Economic and Social History Review, vol. X, No. 3, (Sept. 1973), pp. 244-279.

Section I: the structure of landholding

It can be argued that in Bengal, unlike the Forth Valley, the very nature of rights in land prevented capital formation in agriculture. The concept of "land" was fundamentally different in both societies. It was measured in exactly the same way, the traditional unit being the "plough" or area which could be cultivated by one plough-team in a year. But there the similarity ended. Land in the Forth Valley was also property. Scottish law was based on Roman law, which defined property as "dominium", the absolute right of ownership by a single individual. Rights in land were, therefore, indivisible and two people could not own the same land. This was not the case in Bengal. Indian law made a distinction between what we may call rights of possession and rights of value. Producers enjoyed rights of possession and could not be removed provided they paid rent. Consumers, or rent-receivers, enjoyed rights of value and were entitled to a share in the produce. Zamindars in Bengal were thus not proprietors like landlords in the Forth Valley, since others also had rights of possession to the same land. Instead, zamindari was a right to a share in the produce of land[5].

5. Robert E. Frykenberg, Land Control and Social Structure in Indian History, (Madison, 1966), pp. 37-41.

As a result, the zamindar "never did, and he does not to this day, stand towards the ryot in the position which the English landlord occupies relative to his tenant... If an English landlord says, I have a fine estate in such and such a country, he mentally refers to the amount of acreage, the fertility of the soil, the beauty of the landscape and so on, not at all to the tenants, the labourers, or the dwelling houses which may be on the land; whereas, if a zamindar makes a like remark, he has in his mind the number and importance of the villages, which form the zamindary, and their respective jummas (rentals), but he takes no thought about the actual land"[6].

A comparison of the structure of "landholding" must, therefore, be constantly aware of this conceptual difference and its practical implications. The agricultural surplus in the Forth Valley belonged to the landlord through his legal right to the means of production, whereas in Bengal the zamindar did not have a legal right to the means of production, but to the agricultural surplus. In what follows, 'landholding' will be used in both senses. The practical implications of this difference for agricultural development were potentially disastrous.

6. J. B. Phear, "Annual Address", Transactions Bengal Social Science Association, vol. 3, 1869, quoted in Ratna Ray, Change in Bengal agrarian society, 1760-1850: a study of selected districts, (Ph.D Thesis, Cambridge, 1973), p. 85.

Firstly, it facilitated the creation of vast estates which were too cumbersome for efficient management. This was a problem even in Scotland where, as Adam Smith wrote: "It seldom happens... that a great proprietor is a great improver."[7]. But landholding in Bengal was much more concentrated than in Scotland. In 1790, over 50% of the total revenue was paid by just twelve families. The greatest of all, the Raja of Burdwan, held over 4,000 square miles and paid over 17% of the total land revenue alone[8].

Nor did the Permanent Settlement significantly alter this pattern. True, between 1794-1819, 70% of zamindari rights were sold because their owners could not pay the revenue demand. But the change was less far-reaching than this figure suggests. "Benami" purchases enabled many estates to be repurchased fictitiously by their original owners. Only about 45% of zamindari rights genuinely changed hands, and of these some 60% were bought by only thirty families[9]. Landholding in Bengal in 1870 therefore

7. Wealth of Nations, quoted Nathan Rosenberg, Perspectives on Technology, (Cambridge, 1976), p. 363.

8. Sirajul Islam, The Permanent Settlement in Bengal. A Study of its Operation, 1790-1819, (Dacca, 1979), p. 3.

9. ibid, Appendix B. and pp. 152-4, 189.

remained far more unequal than in the Forth Valley. For example, the Maharaja of Burdwan owned eight estates with a gross rental of £300,000; his net income was estimated to be £100,000 a year[10]. By comparison, the Duke of Montrose with £4,000 was virtually a pauper.

The structure of landholding in the Forth Valley was much more equal, as Table 4.1 shows. We can divide landlords into seven groups, of which five are landlords, the sixth owner-occupiers and the seventh institutions[11]. At the apex of this social pyramid stood the aristocracy, with an average annual income of £4,000 plus. Next came wealthy landlords with incomes of between £2-4,000 a year. Together, these two groups may be classified as great landlords. In the Forth Valley, they controlled a relatively small share of the economic surplus, less than 12%. The national picture was quite different, however; great landlords in the country as a whole controlled 46% of the surplus. Below the great landlords were the gentry of lairds. They were not a monolithic group, since their incomes ranged from £500-£2,000 a year. The wealthiest lairds had incomes between £1-2,000, middle lairds £500-1,000 and lesser lairds

10. Bengal Financial (Statistics), Proceedings, vol. 181, (1873), Report on Land Tenures, Burdwan. pp. 243-247; Hunter, SAB, vol. 4, p. 67.

11. Loretta Timperley, Landownership in Scotland in the Eighteenth Century, (Ph.D Thesis, Edinburgh, 1977), p. 151.

£100-500 a year. In the Forth Valley, the lairds controlled 65% of the regions agricultural wealth; nationally they controlled 41%. Finally, came the group of owner-occupiers known as "bonnet lairds". Their yearly incomes were below £100 and they often farmed the land themselves. In the Forth Valley, these small landlords shared 13% of the surplus, whereas nationally their share was only 5%. The Forth Valley was thus predominantly a region of small landlords.

Table 4.1

LANDOWNERSHIP IN THE FORTH VALLEY, c. 1770

CLASS	NUMBER	% TOTAL	RENT(£)	% TOTAL RENT(£)
1	1	0.16	4367	3.14
2	4	0.66	11594	8.34
3	18	2.99	24575	17.69
4	33	5.48	25499	18.35
5	191	31.72	40964	29.49
6	355	58.97	18303	13.17
7	10	-	13601	9.79
Total	612	99.98	138903	99.97

Source: Loretta Timperley, Landownership in Scotland in the Eighteenth Century, (Ph.D., 1977, Edinburgh), pp. 373, 351.

Notes: Class 1: aristocracy £4,000 plus
2: wealthy landlords, £2-4,000
3. wealthy lairds, £1-2,000
4. middle lairds, £500-1,000
5. lesser lairds, £100-500
6. "bonnet lairds", below £100
7. institutions.

The second potentially disastrous consequence of zamindari rights in land stemmed directly from the first. Since zamindari estates were too large for efficient management, they were subin feudated. The main instrument of subinfeudation was the patni lease, introduced by the Maharaja of Burdwan in 1799 and legalised by the Government in 1819. What distinguished patni from other subordinate tenures was its permanency. So long as a _patnidar_ paid his rent, which was fixed, he could not be removed; _patni_ became synonomous with permanent tenure. By granting _patnis_, a landlord kept his _zamindari_ rights, but effectively limited his share of the surplus to the permanent rent paid by the _patnidar_[12].

The Maharaja described the results of subinfeudation in his own _zamindari_ of Burdwan. "After some time, the _patnidars_, prompted by an avaricious desire to augment their own profits, granted sub-leases of their patni-mahals to durpatni renters, these persons again adopting the same line of conduct, let out their dupatnis to theirs, and so on, as far as three, four or five under renters. Now when five people expect to derive distinct profits from the same mahals, it is perfectly needless to explain how distressed and miserable the situation of the ryots must be; many of the mahals, in consequence, become deserted and waste, and the amount of the collections has also necessarily decreased"[13].

Yet the extent of subinfeudation among tenure-holders was demonstrably exaggerated. While by 1825 most of Burdwan had indeed been let out by the Maharaja in _patni_,

12. Islam, _Permanent Settlement_, p. 106.

13. _ibid_, p. 108.

very few patnidars created intermediaries themselves. The Road Cess statistics show that by 1873 only 33% of patnidars had subinfeudated their tenures; of darpatnidars, only 5%; while sepatnidars had granted only five fourth-degree chaharanpatnis[14]. By the late 1920's, several grades of tenure-holders were still rare in Burdwan. The Settlement officer reported that "the bujharat in Burdwan does not pose any special difficulties. There is practically no subinfeudation worth the name and subdivisions of tenancies are not very considerable"[15].

Nor was Burdwan exceptional. In Purnea, where patni leases were introduced only in 1838, the first darpatni was not granted until 1874, and the first sepatni as late as 1871. It was noted that a patni of fourth degree "is hardly ever met with, and does not exist in Purnea"[16]. Subinfeudation was not a problem in Dacca. "With regard to the greater part of the lands in Dacca, the superior landlords (zamindars) deal directly with the actual cultivators. The former collect the rents directly from the

14. Hunter, SAB, vol. 4, pp. 79, 82.

15. Burdwan Settlement Record Room, Inspection Notes of Burdwan Settlement, vol. X, 1927-28. Notes, May, 1928 by M. A. Momen, Director of Land Records, Bengal, 1st June, 1928, (typescript), p. 2.

16. Hunter, SAB, vol. 15, pp. 319-322.

husbandmen... The tenures are simple, and there are never more than two middlemen, the talukdar and the howaladar"[17].

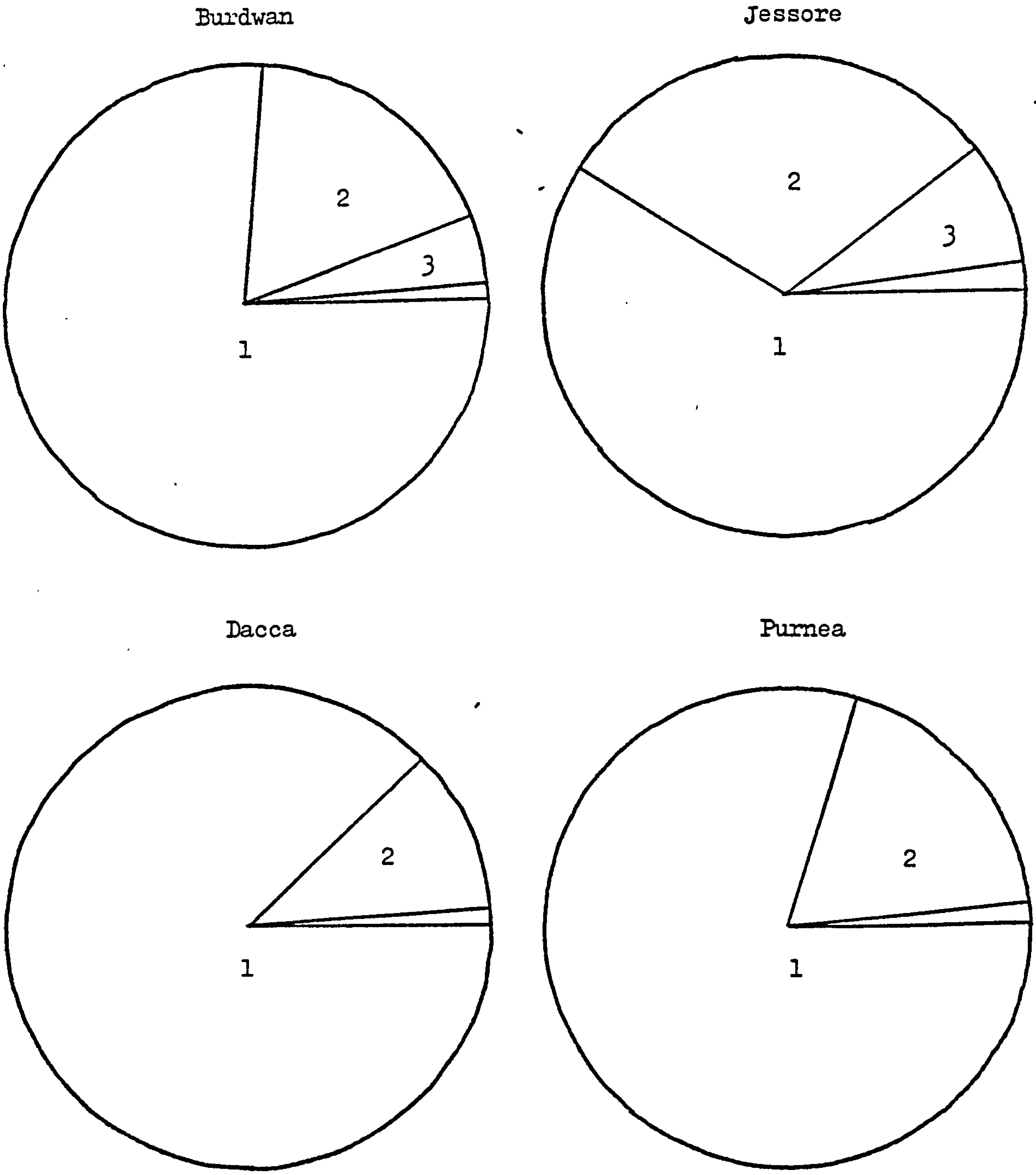
The extent of subinfeudation among tenure-holders is illustrated in the pie-charts opposite (Fig. 4.1). In three out of our four sample districts, tenure-holders of the first grade leasing directly from the zamindar account for over 70% of the total rental paid to all tenure-holders, (See Appendix G). In all four cases, the rents paid to tenure-holders below the second grade is an insignificant proportion of the total. Rack-renting therefore seems to have been the result of an adverse man/land ratio rather than subinfeudation.

Evidently, what prevented zamindars from fulfilling their appointed role as improving landlords was the nature of their rights in land. Zamidari rights extended only to the rent: rights to the land belonged to the cultivator or raiyat. Hence zamindars never controlled the means of production. Subinfeudation reduced their rights to land still further. By 1914, they controlled only 2.13% of the settled area in Purnea and 4.95% in Burdwan. Where they controlled larger areas (31.07% in Dacca and 29.14% in Jessore), their capital resources were more limited (Table 4.2). But while this explains the failure of the Permanent Settle-

17. Hunter, SAB, vol. 4, p. 97.

Figure 4.1
Subinfeudation in Bengal

% distribution of surplus by grade of tenure holder



Tenures		Burdwan	Jessore	Dacca	Purnea
Grade	1	76.45	58.95	87.92	79.70
	2	18.08	30.96	12.07	19.41
	3	5.06	8.33	0.006	0.86
	4	0.36	1.67	-	-
	5	0.02	0.11		
	6		0.01		
TOTAL		99.97	99.97	99.97	99.97

Table 4.2

HOLDINGS BY TENANCY STATUS. BENGAL

(% Occupied area)

TENANCY STATUS	BURDWAN	JESSORE	DACCA	PURNEA
Proprietors	4.95	29.14	31.07	2.13
Tenure holders	14.66	36.56	20.92	18.24
Raiyats at fixed rates	29.37	24.91	1.91	4.92
Settled Occupancy *raiyats*	40.71	0.02	28.66	66.24
Non-occupancy *raiyats*	0.23	0.25	8.02	3.10
Rent-free *raiyats*	8.76	0.005	5.30	0.76
Under *raiyats* with occupancy rights	0.54	8.03	4.07	2.63
Under *raiyats* without occupancy rights	0.74	1.04	4.07	1.95
Total	99.96	99.95	99.95	99.97

Sources: *Settlement Reports*, Statistical appendices.

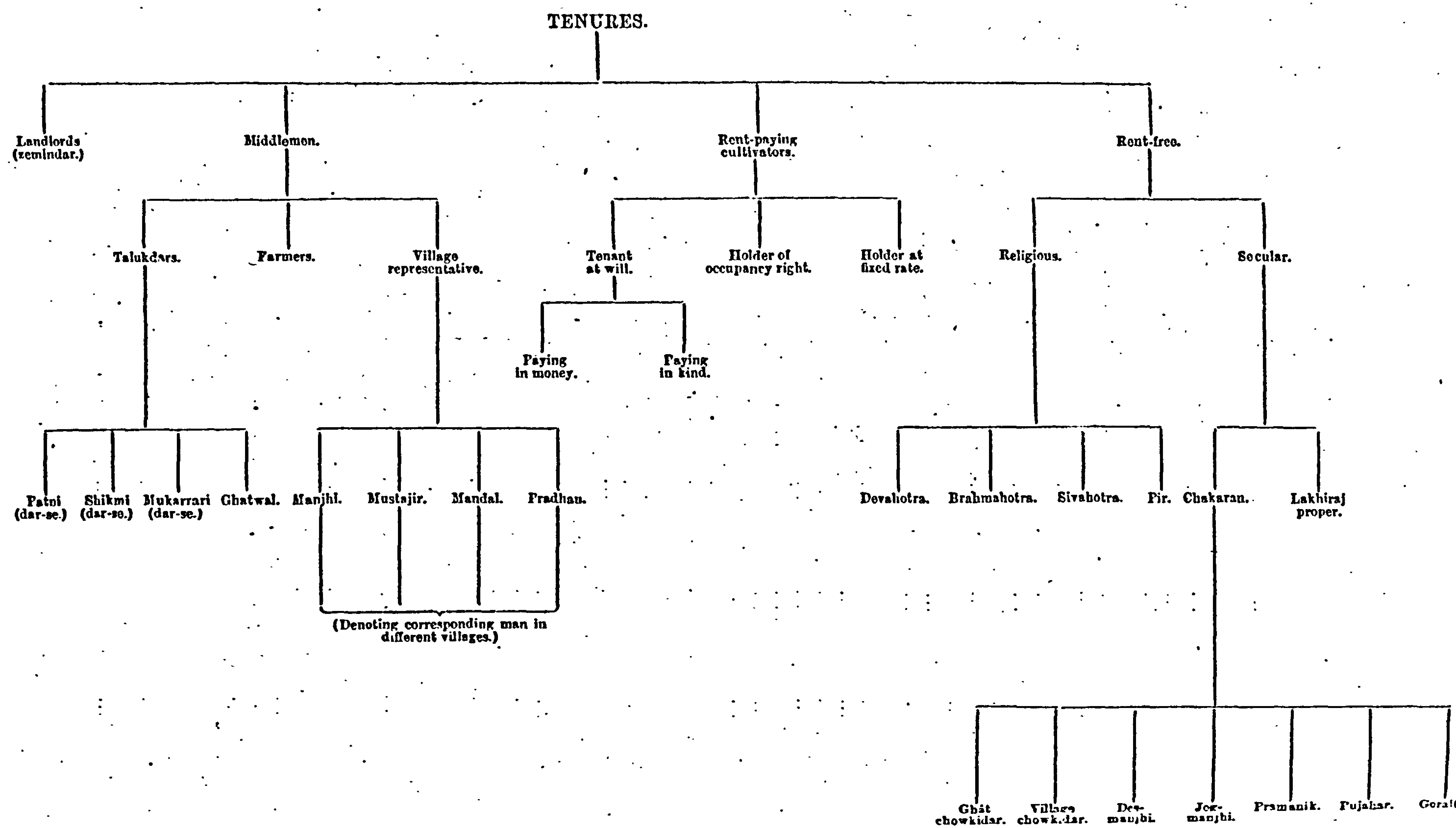
ment to secure the expected results, it cannot explain the absence of an agricultural revolution by some other agency. A change in the organisation of production could have been engineered at the local level by raiyats who controlled the means of production. Why then did Bengal raiyats not take up the mantle offered in error to the zamindars?

The identity of the raiyati elite is obscured by the complexity of land tenure in Bengal, which is illustrated by Figure 4.2. These legal categories were used for revenue purposes and did not necessarily correspond to sociological categories in the countryside. Take the category "rent-paying cultivator", for example. The Bengal Tenancy Act (1885) defined a raiyat as "a person who has acquired a right to hold land for the purpose of cultivating it by himself, or by members of his family, or by hired servants, or with the aid of partners..."[18]. In other words, a raiyat need not necessarily be a cultivator or, indeed, know anything about agriculture. He simply possesses a right to cultivate land. Since all those holding below 33 acres under a zamindar or tenure-holder were classed as raiyats, small and large farmers are lumped indiscriminantely together, and the definition is sociologically meaningless.

18. Report of the Government of Bengal on The Bengal Tenancy Bill, 1884, (Calcutta, 1885), Ch. II, 5(2), p. 22.

Figure 4.2

LAND TENURE IN PURNEA DISTRICT, 1870



The same applies to distinctions between raiyats into holders and non-holders of occupancy rights. In Rangpur district, reported the Collector, "there is no such distinction as occupancy and non-occupancy ryots... The ryot who holds direct from the zemindar is called a jotedar, and his holding is a jote... Among jotedars, the majority must have a statutory right of occupancy under Act X, though most of them would be ignorant of the fact, as the term is not generally recognised in this district, and the right of the district, in fact, has taken the place to a great extent of the statutory right of occupancy". Similarly, legal distinctions between rent-paying cultivators and middlemen made little sociological sense. "The tenure-holders are almost to a man jotedars. The number of ijaradars and talukdars of kinds is so insignificant, that they can be left out of account; and the jotedars are to all intents and purposes ryots... The jotedar who is classed as a tenure-holder, that is, who has ryots under him - in no respect differs from the jotedar who cultivates his own land, except that he is a bigger man in the village. Socially, there is no distinction; he is merely the headman or spokesman of his fellow-ryots"[19].

19. Bengal Revenue Proceedings, vol. 905, (1876). Colln. 14-15. E. G. Glazier, Magistrate and Collector Rungpore-Commr. Rajshahye and Cooch Behar Division, 16 August, 1876, paras. 5,6,13.

Such arbitrary classifications for revenue purposes obviously cut clear across a distinct class of landholders who owned most of the land in a given neighbourhood, known, as _jotedars_. They, and not the _zamindars_, were the closest equivalent in Bengal to landlords in the Forth Valley. "Bengal zamindars excercise no influence over the course of cultivation", writes one nineteenth century observer of Jessore. "They may cut a well, dig a tank, lay out a road, or establish a weekly market. But the whole custom of the country, whether based on traditional precedent or confirmed by judicious legislation, is against their spending capital, as an English landlord does, in scientific agriculture and high cultivation. The introduction of the higher and more lucrative products has been entirely the work of substantial Gantidars, jotedars, or tenant proprietors, call them by any revenue or local term that you choose"[20].

Despite the important role they played in agricultural production, _jotedars_ remain somehwat shadowy figures. Since district administration was concerned with revenue and not with relations of production, we do not know how many _jotedars_ there were or whether they were found throughout Bengal. But their chief characteristics are clear enough.

20. Seton-Karr, "Agriculture in Lower Bengal", pp. 427-428.

Jotedars were distinguished economically from the rest of the peasantry by their ownership of large areas of land. This area varied widely. "The Rungpore *jotes* vary from a rental of Rs. 2 to Rs. 50,000 or more"[21]. Generally, however, *jotedars* controlled a neighbourhood. "These men may own a village, or half a village, or fifty beegahs", writes one observer from Jessore, but it was rate for them to own more than two villages[22]. The *jotedars*, therefore, correspond closely to the Forth Valley lairds, whose incomes also ranged widely but who were generally small landowners associated with one neighbourhood. Like Scottish lairds, and unlike other tenure-holders, *jotedars* were directly involved with production. "The bigger tenures, like talooks and pattanis, do not have much *khas* lands in their possession, excepting beels, roads and mud *khals*. The smaller tenure-holders, like *jotedars* and gantidars, however, have quite an appreciable proportion of their lands in *khas* possession"[23]. *Jotedars* combined the roles of landlord and manager through farming by hired labour or by supplying credit to sharecroppers. The control of village labour and the supply of credit formed the economic basis of the *jotedars*' power as much as ownership of land.

21. *BRP*, vol. 905(1876), *Colln. 14-15*, para. 2.

22. Hunter, *SAB*, vol. 2, p. 259.

23. Momen, *Jessore Settlement Report*, pp. 105-106.

Such power derived from a network of client-patron relationships extending over several generations. "These tenure-holders", wrote one official from Faridpur, "have more permanent interest in land than a temporary jumma-holder... The jotedars of the 2nd and 3rd class... are permanent residents in their villages, and are greatly attached to their home. Zamindars, patnidars, or other superior jotedars, may change, but these jotedars never... It is no unusual sight to see a jotedar in a village, whose holding has descended to him from remote times, reaching far back before the permanent settlement; in some cases, even before the Company's Dewanny"[24].

It is evident from the Table 4.2 that this rural elite controlled a large area. Raiyats at fixed rates and raiyats with occupancy rights held over 70% of the occupied area in Burdwan and Purnea and about 60% in Jessore. In Dacca, where zamindaris were very small and many proprietors engaged in direct cultivation, they held only 30% of the occupied area (Table 4.2). Unfortunately, the statistics for our four districts do not tell us how much of the raiyati land was held by wealthy raiyats. In Murshidabad

24. Bengal Statistics Proceedings, vol. 181, (1873); File 6: 35-36. Deputy Collector Fureedpore- Collector Fureedpore 10 Sept., 1873. Para. 19, p. 364.

district, next door to Burdwan,35.1% of raiyati land was owned by farmers holding above five acres[25]. The minimum requirement for self-sufficiency was between four to five acres: those holding less than four acres in Burdwan were forced to supplement their income by working as hired labourers[26]. Assuming that "surplus" farmers were those holding five acres and over, 35% of the raiyati area may be taken as the area held by wealthy raiyats.

25. Quoted Ray "Crisis Bengal Agriculture" p. 260, Table 3.

26. Peterson, Burdwan Gazetteer, p. 116.

It is now possible to calculate the area available for lease. To the area held by wealthy raiyats must be added the land occupied directly by zamindars and tenure-holders. Virtually all would have lost caste by touching the plough, and either sublet their land or farmed with hired labourers. In Dacca, for example, "The Brahmans are generally talukdars... they have also occupancy rights in cultivated lands which they let in barga... Brahmans do not plough the land or do any menial work for fear of loss of caste"[27]. Similarly in Purnea the tenure-holders, "though nominally agriculturalists,... do not, by reason of their high caste, plough the land by themselves, but keep Goalas and other middle caste servants to do the field work"[28]. On average, it appears that 50% of the occupied area was directly under the control of surplus farmers and zamindars and tenure-holders. The remainder being occupied either by marginal farmers or the homestead plots or under-raiyats. All of this area was available for lease.

27. Census Report, 1891, Dacca district, p. 12.

28. Census Report, 1891, Purnea district, p. 16.

Table 4.3

LAND AVAILABLE FOR LEASE IN SAMPLE DISTRICTS
(% settled area)

DISTRICT	RAIYATS	TENURE-HOLDERS	ZAMINDARS	TOTAL
Burdwan	28.12	14.66	4.95	47.73
Dacca	16.78	20.92	31.07	68.77
Jessore	20.87	9.32	2.41	32.60
Purnea	27.86	18.24	2.13	48.23
Average				49.33

Source: Table 4.2 above.

Although *jotedars* were themselves protected from excessive rent increases, their land was leased to others at the full market rate. *Korfa raiyats* "generally hold under the *jotedars*, who pay rent to the zamindar, and often pay him in money or in produce three times what he pays to the zemindar. They are the actual cultivators of the soil, and what they pay represents the rent which can by competition be obtained for the land according to the ordinary rules of supply and demand"[29]. What the *jotedar* extracted

29. *BRP*, vol. 905, (1976), Colln. 14-36. E. V. Westmacott, Coll. Dinagepore - Commr. Rajshahye and Cooch Behar Div., 29 June, 1876. Para. 17.

as rent in his role as landlord was set by the market, as was rent in the Forth Valley.

It is still possible that the high rents charged by _zamindars_ and tenure-holders succeeded in deterring _jotedars_ from investing in agriculture. This seems unlikely, for two reasons.

Firstly, _jotedars_ were a force to be reckoned with politically. Behind the tenancy legislation of 1859 and 1885, lurked the British fear that conflict between _jotedars_ and _zamindars_ might escalate to threaten British rule. Such a threat was unlikely to come from the _zamindars_. The Permanent Settlement had been designed to ensure their loyalty to British rule, and had succeeded brilliantly. During the Mutiny of 1857, the _zamindars_ fell over backwards in their eagerness to support the government. The Maharaja of Burdwan supplied transport for the troops, while Jaykrishna Mukherjee of Utterpara raised a militia from his own tenantry[30]. But such demonstrations of loyalty were taken as proof of political weakness. Hard on the heels of the Mutiny came Act X of 1859, which marked the first statutory recognition of rights in land other than _zamindari_. This did not end the conflict and fresh legislation became imperative after the peasant revolt of 1873.

30. Hunter, _SAB_, 4, p. 143; Nilmani Mukherjee, _A Bengal Zamindar; Jaykrishna Mukherji of uttarpara_, (Calcutta, 1975). pp. 193-194.

The Bengal Tenancy Act of 1885 was designed to give a privileged group of small landowners statutory protection from rent increases by their superior landlords. Its chosen legal instrument was the occupancy right, which was arbitrarily fixed at twelve years, and from which those who actually worked the land were deliberately excluded. "We have seriously considered whether the acquisition of a right of occupancy should not be limited in all cases to the actual cultivator of the soil," reported the Rent Commission. "Having examined the subject in all its bearings, we have come to the conclusion that such a rule, if laid down, would excercise a disturbing influence... If all <u>korfas</u> or under ryots were converted into ryots having or able to acquire a right of occupancy, some of us think that the rate of rent for occupancy ryots would be forced up to such a point, as it would become necessary to convert the superior ryot into a tenure-holder or under tenure-holder..."[31]. This would have destroyed the purpose of the Act, which was "to strengthen, or rather to maintain, the position of the substantial ryot"[32].

Secondly, the <u>jotedars</u> and not the <u>zamindars</u> were the beneficiaries from the rise in agricultural prices after

31. <u>The Report of the Rent Law Commission</u>, (Calcutta, 1880), vol. 1, pp. 13-14.

32. <u>Report of the Government of Bengal on the Proposed Amendment of the law of landlord and tenant</u>, (Calcutta, 1881), vol. 2, p. 908, para. 4. Notes on the proposed Rent Law by E. V. Westmacott, Esq., Collector of Noakholly.

1870. This is well illustrated by the rent-revolts in eastern Bengal in 1873[33].

Several features of the revolt highlight the changing balance of power in the countryside. First, revolt occurred not in economically depressed Bihar, but in the ferttile alluvial _pargana_ of Ishafshahi in Pabna district, which was highly prosperous and the centre of jute cultivation. The revolt was not the work of a rackrented tenantry goaded beyond endurance but a calculated attempt by _jotedars_ to keep the profits from rising agricultural prices. Secondly, it betrayed the legal weakness of the _zamindars_ who found it impossible to enhance rents under Act X, and instead resorted to illegal cesses. It was the attempt by the Banerjee family of Dacca to consolidate these cesses (or _abwab_) onto the rental which sparked the revolt. Thirdly, the revolt showed the financial cost of legal action against a united and determined tenantry could only be borne by the richest _zamindars_. About 300 villages combined against the Banerjees, who spent about Rs. 30,000 in court fees alone and collected no rent for two years. Others found the game not worth the candle. "The lengthy and expensive process that a zamindar has to go through in realising his rents from a recusant tenantry means very

33. B. B. Choudhuri, "The Story of a Peasant Revolt in a Bengal District", _Bengal Past and Present_, vol. XCII, (July -Dec. 1973), pt. II, pp. 220-278.

frequently ruin to a small estate holder with little or no private capital to fall back on. Even supposing that he can manage to keep his estate from being sold, the execution of the decrees he has obtained by no means reimburses to him the amount he has expended in obtaining them, plus the amount of rent due"[34]. All these circumstances suggest that the _jotedars_ captured the lions share of the unearned increment from rising prices.

In this they had the blessing of the state. Legally, Act X of 1859 entitled landlords to raise rents on the grounds that the produce or productive powers of the land had increased otherwise than by the agency of the _raiyat_. But the revolt showed Act X to be unworkable in practice. It specified no rule or principle by which the increase could be determined. This led to a crop of contradictory judgements in the courts. In the case of Hills vs Isshore Chose (1862), the _zamindar_ was awarded the full value of his labour and the profits on his capital. Three years later, this judgement was reversed. The Great Rent Case (1865), laid down that the _zamindar_ could only increase the rent so that it bore the same proportion that the increased gross value of the produce boreto the previous gross value. Neither ruling helped the _zamindars_. "The rule of propor-

34. _Bengal Revenue Proceedings_, vol. 905, (1876). Colln. 14-69/70. F. B. Peakcock, Offg., Commr. Dacca Div-Offg. Revenue Dept., Sept. 1876, para. 18.

tion... has miscarried in practice", reported the Government of Bengal. "The first term in the proportion is the former gross value of the produce at the time when the rent was previously fixed. Not only may that time be remote and hard to prove, but even if it be ascertained, it may well be impracticable to show the amount and value of the produce at that period. One proprietor is said to have spent a lakh of rupees without much practical result... The zamindars now seldom, if ever, attempt to work the rule of proportion in their own interests"[35].

Legislation was expensive because the zamindar could not sue a village collectively, but had to institute a suit against each raiyat individually. "Notoriously, the enormous cost of the proceedings necessary to obtain the enhancement of rent though the courts a considerable estate, or a portion thereof, acts as a deterrent to a large number of landlords from prosecuting their claims through the courts"[36].

35. Selections from the Bengal Tenancy Act, 1885, (Calcutta, 1920), p. 16. Govt. India - H. M. Secretary of State for India. 21 March, 1882. Para. 56.

36. B.R.P., vol. 905, (1876), Land Revenue Colln 14-21/22. F. R. Cockerill, Commr. Rajshahye and Cooch Behar Div. - Sect. Revenue Dept. 14, Jan, 1870, para. 22.

Finally, when rules for enhancement because of a rise in prices were eventually laid down by the Bengal Tenancy Act of 1885, they referred only to a rise in average local prices of staple food crops. As one commentator noted, "This clause ... authorises an enhancement of rent... irrespective of the particular crop - such as jute, indigo, opium, and ganja - grown by the raiyat. The raiyat can grow what crop suits him best, without thereby subjecting himself to pay enhanced rent"[37]. An earlier proposal to allow landlords to tax commercial crops was vetoed by district administrators. "I think the proposal", wrote one,"to impose double assessment on lands cultivated with valuable crops is of questionable expediency... All the landlord can in fairness claim is a reasonable return from the land according to its quality at the time he let it. If the ryot introduces jute or any valuable crop, I think no additional rent should be paid simply on this account. Moreover, the profits of the several more valuable crops vary so considerably that one general rule to the effect that all may be taxed (at the discretion of the Courts) up to double the amount paid by ordinary crops can hardly fail to lead to misunderstanding and difficulty"[38]. Thus, the profits from lucrative commerical crops like jute were left in the hand of the raiyat.

37. M. Finucane, The Bengal Tenancy Act, (Calcutta 1886), p. 61.

38. BRP, vol. 1159, (1878). Colln. 14-38/40. E. H. Whitfield, Collector Burdwan - Commr. Burdwan Division 24 Dec. 1876.

Legally and in practice, therefore, the _jotedars_ played a commanding role in the countryside. Their power far exceeded that of farmers in the Forth Valley.

> "What would not an English tenant farmer give for such an interest as a so-called occupation ryot...? A permanent right in the soil, transferable and divisible at pleasure; his rent often much less and never more than 1/4th of the gross produce of the land; no tithes, rents or taxes to pay, except road cess; no expensive carts and horses; no barns of farm buildings to keep in repair; a soil renewed and fertilised every year by the rains; with no manure required, and a very small modicum of labour"[39].

We conclude that, in the _jotedars_, Bengal possessed a rural elite identical in virtually every respect to the landlords of the Forth Valley. _Jotedars_ were small landholders, like the majority of their Scottish counterparts. Like the lairds, they were also deeply rooted to their localities. Finally, because they were directly involved in production and controlled large areas of land, they were well-placed to invest in agriculture. The obstacle to capital formation in Bengal was not, therefore, the nature of _zamindari_ rights in land.

39. _Report of the Government of Bengal on the Bengal Tenancy Bill, 1884_, (Calcutta, 1885), vol. 3, p. 8. T. W. Holderness, Undersecretary Govt., of India, Revenue and Agric. Dept. - Secy. Govt. Bengal Revenue Dept., 2nd Jan. 1883.

Section 2: land tenure and productivity

The invocation of the parasitic landlord to explain low agricultural productivity in Bengal is based on the widespread existence of sharecropping and moneylending. Together these institutions formed the mechanism whereby the economic surplus was extracted from the peasantry and effectively denied them any economic incentives for innovation. But this reading of agrarian history remains suspect.

Firstly, it can be argued that sharecropping was no more exploitative a choice of tenure system than that made by their counterparts in the Forth Valley. The contention that sharecropping reduces innovation and productivity is as old as economics itself, since Smith condemned the institution in The Wealth of Nations. But the first full discussion of sharecropping is that by Alfred Marshall. It remains the source on which much of the contemporary debate over sharecropping in India is based. (Alfred Marshall, Principles of Economics, (8th edn., London, 1969), Ch. IX.)

To understand the behaviour of the landlord, one must see the world as he sees it. He has land and needs labour to cultivate it. Three choices of tenure system were open to the Bengal landlord and the Scottish landlord: owner operation, sharecropping, and fixed rental or leasehold. An owner operator hires labour for a fixed wage, organises production himself, bears all the risks and reaps all the profits.

Under the leasehold system, the surplus farmer has no risk and becomes a pure _rentier_; the tenant assumes all the risks, makes all the decisions and reaps the profits. The tenant, in effect, becomes a small entrepreneur. Finally, sharecropping is a tenure arrangement whereby the surplus farmer and the tenant share the risks, usually on a 50-50 basis. Of course, there are more than three forms of tenure. A landlord can appoint an intermediary, for example, as many large _zamindars_ and tenureholders did. This simply means that the choice of tenure with the cultivator devolves on the middleman rather than the landlord. Once again, there are only three choices. Why then did the Bengal _jotedar_ and the Scottish landlord make different choices?

These choices are compared in Fig. 4.3 in which a wage payment system is compared with a sharecropping system. Assume that the landlord has a unit of land at his disposal. The marginal revenue product (M) is measured on the vertical axis, and the input of labour (L) on the horizontal axis. The line AC is thus the marginal revenue product curve of labour. The going wage is given by the line OW.

Suppose the landlord chooses the first option, and cultivates his land with hired labour. Under perfect competition the landlord will employ OD labour, since at this point the marginal revenue product of labour is equal to the wage (W=M). The income of the landlord is then at a maximum. Total output is OABD, of which OWBD goes to labour, while the landlord's income is AWB. If, instead, the landlord chooses to lease his land on fixed rent, his income will remain the same (AWB), since rent is equal to the marginal productivity of land. All that has changed is that the risk of harvest failure has passed from the landlord to the tenant.

What is the landlord's income under sharecropping? Provided that the labour input remains the same as under direct cultivation with hired labour, output will be unchanged at DA. The sharecropper's income must at least be equal to that of a hired labourer. Typically, it is fixed at 50% of marginal revenue product (OE). Given these conditions, the sharecroppers income is then OEGD, the landlord's income EABG, or the remaining half of the output. Thus, under all three forms of land tenure the landlord's income remains the same, since AWB = EABG. In other words, the three tenure systems are equally profitable for the landlord and equally exploitative for the tenant.

It might be objected that the assumption that the sharecropper's labour input will remain at OD is unrealistic. If the tenant is a profit maximiser, then he will employ labour only up to OR, where his 'wage' is equal to his marginal revenue product. At this point, the total output is given by ORQA. With output at ORQA, the sharecropper's income is given by ORFE, and the landlord's income is reduced to EFQA. Since EFQA is less than his income under direct cultivation (AWB), sharecropping is clearly less profitable for the landlord.

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Figure 4.3

Landlord's income and land tenure

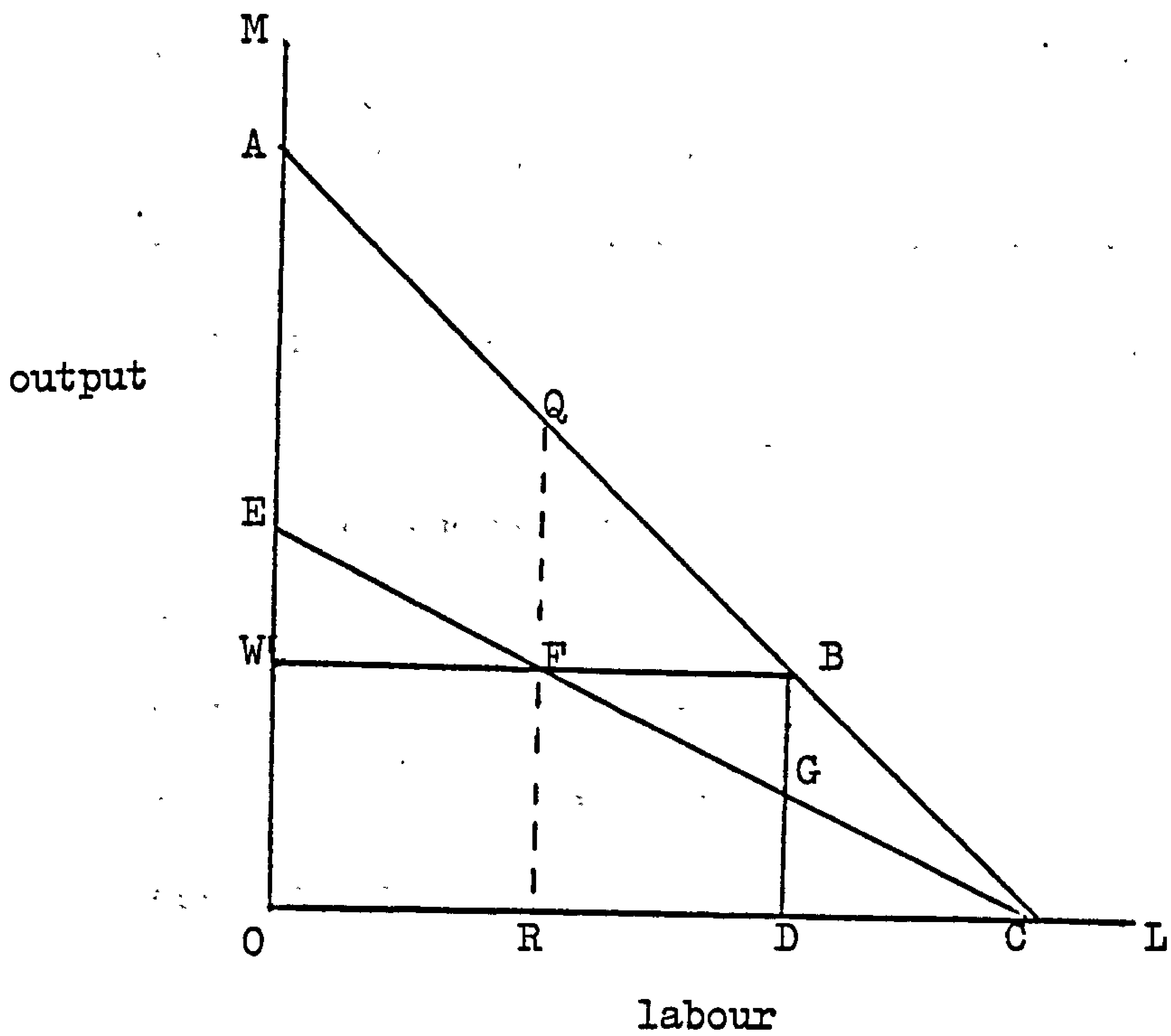
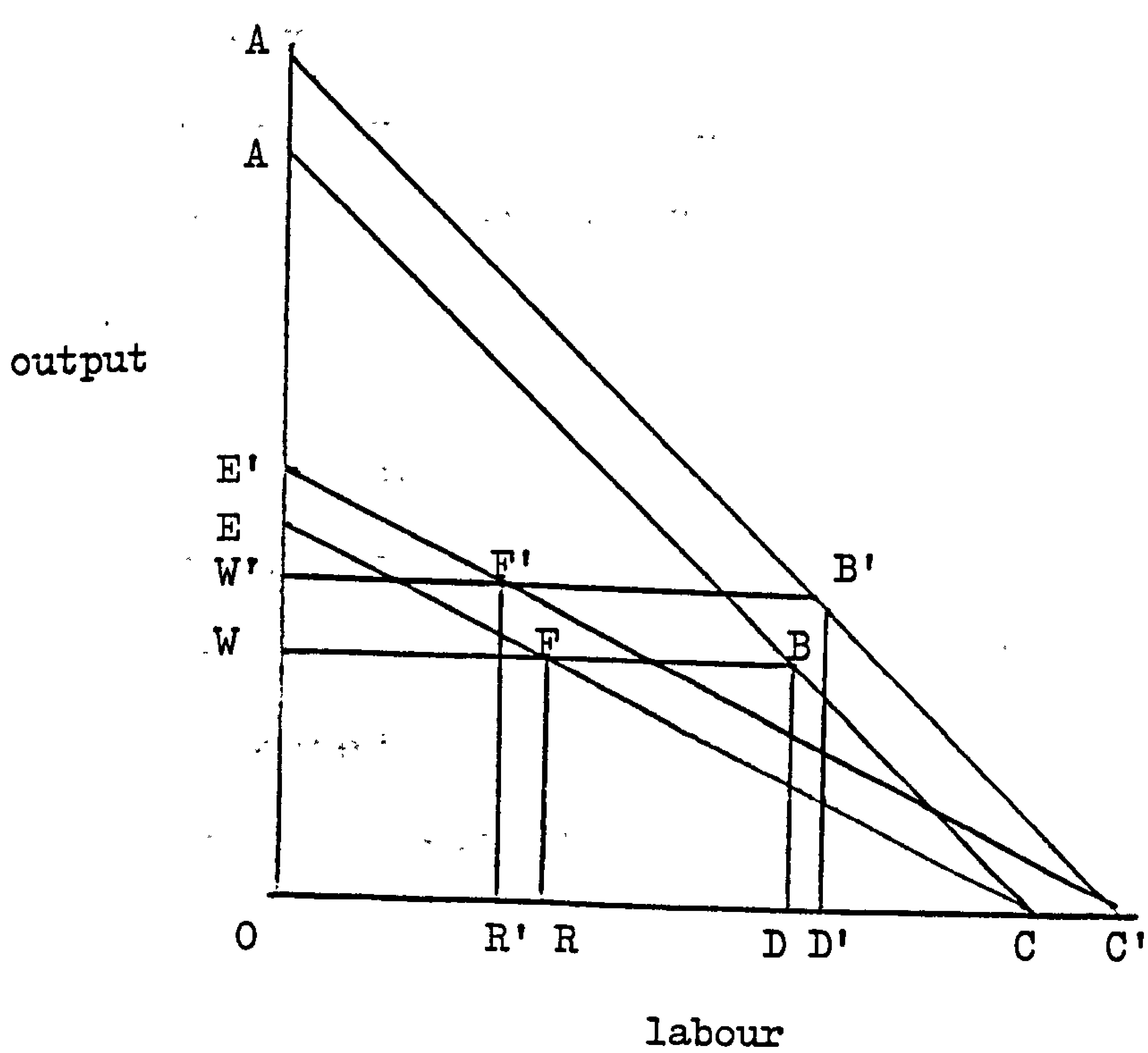


Figure 4.4

Sharecropping and innovation



In reply, two points are in order. Firstly, the landlord can ensure labour inputs remain at OD by finding 'good' tenants and evicting those 'bad' tenants who reduce their labour inputs. As Marshall points out, 'if the tenant has no fixity of tenure, the landlord can deliberately and freely arrange the amount of capital and labour supplied by the tenant' (Principles, p. 536). Secondly, much of the empirical evidence suggests that yields are the same under sharecropping as under direct cultivation (see below, p.300). Since in traditional agriculture output depends primarily on inputs of labour, the evidence strongly suggests that labour inputs are the same under both forms of tenure.

Since under each form of tenancy the jotedars income remained the same, his choice was not dictated by their relative profitability. By the criterion of landlord's income, sharecropping in Bengal is just as 'capitalist' as direct cultivation in the Forth Valley. What determined choice of tenure was their relative operational advantages.

On the supply side, sharecropping offered economies of scale. Rice was vastly more labour intensive than any subsistence crop grown in the Forth Valley, jute even more so. Moreover, in Bengal, the timing of these labour inputs depended on an unpredictable monsoon rainfall. Transplanting, which constituted 11% of the total labour input for aman paddy, had to be done within hours of the first monsoon shower. The operation required large numbers of labourers - 13 per acre - to do the job in one day. If transplanting were not performed within hours of the optimal time, yields were substantially reduced. The large number of labourers required posed a serious problem of supervision for the <u>jotedar</u>, especially in Bengal where holdings were not compact units but fragmented into dozens of scattered plots. Share-cropping had the operational advantage of making supervision unnecessary.

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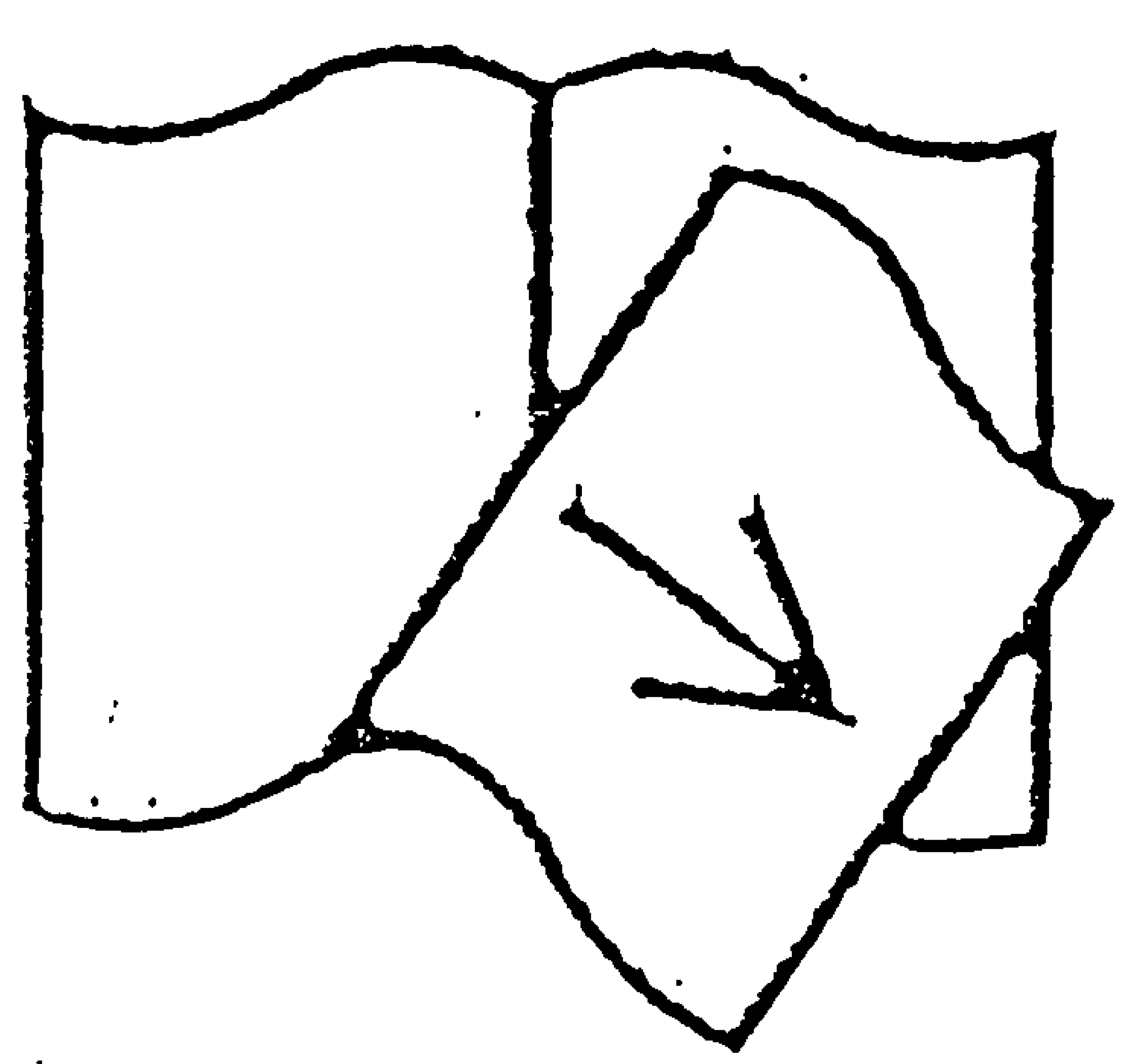

Moreover, the seasonality of monsoon agriculture meant that there was always a problem of labour shortage at peak periods. Hence, landlords engaged in direct cultivation frequently gave loans in return for labour, either for a stated period or until such loans were repaid. This ensured the landlord of first call on the available labour force at seasonal peaks. Without such credit controls, landlords attempting direct cultivation would have experienced the same problems found on the Governments model farms:

> "Whenever labour is required at the farm for some special work, the cultivators also for the same reason require them and the result is that there is inevitably a dearth of skilled labour. The main labouring classes of this district are Baurias and Santals. But they are very uncertain, because they are very poor and consequently are under some obligation to well-to-do cultivators of their villages. So they must work for these cultivators at a low rate. Besides this, they get their midday meal from the cultivators for whom they work. Hence, in the season it is very difficult to get labourers for the farm even at high wages... Without the direct control of labour in our own hand,

it will be very difficult to run the farm either experiementally or commercially"[41].

The twin problems of lanlord supervision and seasonal labour cycles thus effectively reduced the operational advantages of direct cultivation in Bengal. Modern studies of Bangladesh agriculture suggest that the largest viable farm a landlord can cultivate with hired labour is ten acres[42]. In the Forth Valley, where agriculture was characterised by a narrow range of long-duration crops and where labour inputs were only half as large, landlords faced no such constraints.

On the demand side, sharecropping had one decisive advantage for the tenant. Because the risks of cultivation are shared equally with the landlord, he was guaranteed some income even in bad years. For korfa raiyats living at low levels or real income, sharecropping is thus preferable to a cash rent with fixed annual payments. Since it also guarantees employment, sharecroppers and landless labourer werefreed from the uncertainty of the labour market. Finally, as in any agrarian society, tenants of whatever

41. Report of Agricultural Department, Bengal, 1923-24. App. X, Annual report on District Agricultural Farm. Bankura, 1923-4, p. IX.

42. M. A. Jabbar, "Relative Productive Efficiency of Different Tenure Classes in Selected Areas of Bangladesh". The Bangladesh Development Studies, vol. V, No. 1, (July, 1977), p. 26.

kind enjoy higher status than those without any rights to land.

Granted that the jotedar's choice of tenure system was as rational as their Scottish counterparts, was it equally favourable towards capital formation? The claim that share tenancy is an obstacle to innovation in agriculture, familiar in economics from Adam Smith onwards, is supported by the "family-farm ideology" of Western agricultural economists[43]. Their argument is a simple adaptation of the neo-classical theory of the firm. Since under sharecropping the jotedars share of the produce is fixed, he has no incentive to invest.

The situation is illustrated in Fig. 4.4. As before, line AC represents the marginal revenue product curve, WB represents the marginal cost curve, and EC the sharecropper's marginal revenue product curve. It is assumed that the sharecropper is a profit maximiser, and uses his own labour only up to the point where the marginal cost curve crosses the marginal revenue product curve (F). His labour input is thus OR.

43. eg. Dale W. Adams and Norman Rask, "The Economics of Cost-Share Leases in Less Developed Countries". American Journal of Agricultural Economics, vol. 50, (1968), pp. 935-942. Charles Issawi, "Farm Output under Fixed Rents and Share Tenancy". Land Economics, vol. 33, (1957), pp. 74-77. Rainer Schickele, "Effects of Tenure Systems on Agricultural Efficiency". Journal of Farm Economics, vol. 23 (1941), pp. 185-207.

Now we introduce an innovation which increases the marginal revenue product, but also requires investment, thereby increasing costs. The new marginal product curve is A'C', the new marginal cost curve W'B', and the sharecropper's new marginal product curve E'C'. The important point is that the new marginal product curve for the tenant (E'C') crosses the new marginal cost curve (W'B') at F', resulting in a new labour input OR', which is less than the original input OR. Hence, Issawi argues, sharecroppers will not undertake any investment unless the increase in marginal revenue product is more than twice as big as the increase in marginal costs. In the latter case, F' would lie to the right of F, and thus the new labour input (OR') will be greater than the old.

This argument rests on two assumptions. Firstly, that the sharecropper is a profit maximiser. However, as we have seen, yields of sharecropped land suggest the tenant's labour input is at OD rather than OR. If so, then, labour inputs will not be reduced after innovation, but increase to OD'. Secondly, as Issawi points out, if the landlord bears more than half the costs of the investment while sharing equally in the returns, or if he takes less than half the returns while sharing equally in the costs, then any investment which increases returns by at least as much as costs will be profitable for the tenant.

Issawi argues that such behaviour is unlikely. Yet the evidence from nineteenth century Bengal suggests considerable flexibility in the supply of inputs. Quantitative evidence from two districts is presented in the table below:

Table 4.4

Landlord's supply of inputs on sharecropped land

(per cent)

Inputs	Mymensingh	Rajshahi
Seeds	42	16
All	2	16
None	56	68
Total	100	100

Source: A.K. Jamieson, Settlement Officer, M.C. McAlpine, Offg. Director of Land Records, Bengal - Secy. Govt. Bengal, Revenue Dept., 14 April, 1914. Bengal Revenue Proceedings, 1914, vol. 9389.

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Seeds	42	16
All	2	16
None	56	68
Total	100	100

Source: A.K. Jamieson, Settlement Officer, M.C. McAlpine, Offg. Director of Land Records, Bengal - Secy. Govt. Bengal, Revenue Dept., 14 April, 1914. Bengal Revenue Proceedings, 1914, vol. 9389.

In the majority of cases, the cost of inputs were met by the tenants. Descriptions of share-rental contracts shows they were not set by custom but by mutual bargains. In Jessore, for example, "the bargadars, as a rule, agree to pay half of the produce only when the owner of tenant supplies the necessary seed. The extent of the share also depends on the quality of the soil. For first class land, the owner does not supply any seed, for second class land, he supplies half the quantity required, for third class land, he supplies it all". But even if the jotedar alone were to pay for improvement, he could still have recouped his capital. The model assumes that the jotedars share of output is fixed. As with inputs, however, shares were flexible. "In the Narail subdivision also the share is not always half and half, but varies according to the nature of the soil, the crops cultivated, the special agreements made &c..."[44]. Where jute was grown by sharecroppers, the jotedars' share was only six annas or 37%. Obviously contracts in Bengal adjusted to suit the profitability of different crops and soils. Besides, the tenants' share of output is limited by the presence of labourers working for day wages. Were the tenants' share of net output much more than the labourer's real income,

44. O'Malley. Jessore Gazetter, p. 83.

the *jotedar* would find it more profitable to adopt direct cultivation. Share contracts were not fixed, and hence the argument that share tenancy prevented capital formation by the *jotedar* breaks down.

Modern studies of land tenure and productivity lend little support to the view that sharecropping creates inefficiency. Unfortunately data on productivity classified by both farm size and tenure are unavailable for our study area. Instead, one finds one-way classifications between productivity and tenure or between productivity and farm size[45]. Nevertheless, the results are suggestive. There is no evidence that sharecropping has an adverse effect on productivity. Quite the reverse. Hossain compared productivity between tenants and owners on farms of the same size in Bangladesh[46]. He concluded, "The hypothesis that tenants' productivity is lower than that of owners' can be rejected... the comparison of performance of tenants and owners (after controlling for the impact of (farm) size) fails to indicate that tenancy has any effect on productivity"[47].

45. Mahabub Hossein, "Farm Size, Tenancy and Land Productivity: An Analysis of Farm Level Data in Bangladesh Agriculture". *The Bangladesh Development Studies*, vol. V, No. 3, (July, 1977), pp. 285-348 and M. A. Jabbar, *"Relative Productive Efficiency of Different Tenure Classes in Selected Areas of Bangladesh"*. The Bangladesh Development Studies, vol. V, No. 1, (July, 1977), pp. 17-50.

46. Hossein, *op cit.*, Table VII, p. 314.

47. *ibid*, pp. 315, 318.

Both Hossein and an earlier survey by Jabbar based on a different sample found no difference in yield between owner-operated and sharecropped farms[48]. Indeed, productivity was generally higher on sharecropped farms because of more intensive cropping[49]. This seems only logical given that sharecroppers normally have larger families and thus more labour.

There remains the charge that sharecropping creates allocative inefficiency through a less intensive use of labour and other current inputs by the tenant. The historical evidence for this in nineteenth-century Bengal is impressionistic. In Dacca district, according to one British official, the adverse effect of the sharecropping were obvious even to the naked eye.

> "I have walked over villages when the first spring showers have fallen, and I pointed out to the villagers at sight their <u>barga</u> lands. In 9 cases out of 10, my description has proved correct. The value of the crop depends almost entirely on ploughing at the right time when the rain has softened the land. The cultivator at once turns to his cash-paying lands; his <u>barga</u>

48. Hossein, <u>op. cit.</u>, Table IX, p. 317; Jabbar. <u>op. cit.</u>, Table XVII, p. 43. Similar results have been found in other traditional agricultures. See the model study by V. W. Ruttan, "Tenure and Productivity on Phillipine Rice Producing Farms". <u>The Phillipine Economic Journal</u>, Vol. v., No. 1, (1st semester, 1966), p. 55, Table 1.

49. Hossein, <u>op. cit.</u>, Table VIII, p. 316.

lands are left until his other lands have been completely tilled. When the crop begins to appear, the difference is no less noticeable, especially in the case of jute. The jute that grows on barga lands is left to fight its own battle with the weeds, and the result is a crop of jute inferior in quantity and quality which can only constitute the dregs of the market... The barga system thus inevitably results in bad agriculture and bad economy..."[50].

This view is also supported by the modern evidence. Tenants used less manure and less chemical fertiliser than owners with farms of the same size[51]. When the comparison was extended to inputs on mixed tenant farms, (i.e., those with both owned and rented land), this pattern was confirmed. "The results indicate that sharecropped land is, indeed, cultivated less intensively than owned land... In the two areas taken together, the tenant produced about 10% lower output on the sharecropped land compared with that on his own land"[52]. Impressionistic evidence from village studies suggests similar practices: "Sharecroppers are more interested in cultivating their own fields than the plots of others. The cowdung which they have collected,

50. B.R.P., vol. 9389 (1914), Nos. 18-19. F. D. Ascoli, Settlement officer Dacca - Dir. Land Records, Bengal. 1st Feb. 1914.

51. Hossein, op. cit., Table IX, p. 323.

52. ibid. Table XIV, p. 328.

for instance, is mainly spread on their own land. Only if some is left over is the sharecropped land manured"[53].

It remains possible, however, that this represents an efficient allocation of scarce resources since labour is scarce at peak periods and there is only enough manure for the best land.

> "It is true", argued the settlement officer of Jessore, "the barga lands are not always as well cultivated and looked after as the Jamai lands, but this is not because the bargadar intenionally neglects to cultivate the barga land properly... If he had all the lands on cash rent, even then he could not possibly cultivate all the lands at one and the same time. The class of tenants who hold land on barga are usually poor and cannot afford to employ hired labour at the time of the jo (opportune time) to cultivate all his land at once. Whether held in barga or cash rent some lands must be cultivated by the poorer class of tenants after the jo is over and their yield must be less. This is not fault of the barga system"[54].

53. Jenneke Arens and Jos van Beurden, Jhagrapur. Poor peasants and women in a village in Bangladesh, (Amsterdam, 1977), p. 108.

54. Momen, Settlement Report, p. 113.

Confirmation that such behaviourmay represent the skilful husbanding of scarce resources comes from a recent village study in Bangladesh, whose authors write: "A general complaint is that owners sublet those plots which are of poor quality and give low yields. Often the plots are difficult to reach"[55]. In general, it appears that the superior productivity of sharecropped farms is balanced by their inferior application of fertiliser and manure, leaving no observable difference in productivity between owner and tenant. Either way, the effect of sharecropping on productivity is unlikely to have been large, since a special survey of four thanas in Dacca district in 1912-13 revealed that share-tenancy accounted for only 14% of the cultivated area[56].

A more promising case for the parasitic landlord may lie in the nature of moneylending. We saw earlier how systems of tenancy in Bengal gave jotedars much stronger control over their employees than landlords in the Forth Valley. Thus, under owner-operation wage labourers were often tied to the jotedar by means of consumption loans. Similarly, under sharecropping, tenants depended

55. Arens and van Beurden, op. cit., p. 108.

56. B.R.P., vol. 9389, (1914), Nos. 18-19; cf. eighteenth century France where between 75-87% of surplus producing farms were under share tenancy and 85% of all tenants in 1789 were sharecroppers. Robert Foster, "Obstacles to Agricultural Growth in Eighteenth Century France", American Historical Review, vol. LXXV, No. 6, (Oct. 1970), pp. 1604-1605.

on the *jotedar* for the supply of seed and often other inputs as well. In both cases, *jotedars* controlled the credit as well as the land and labour markets. This, for some, explains why *jotedars* were unwilling to provide capital for investment. By investing to raise output, the *jotedar* risks breaking the dependence of his employees on credit. Any profits the *jotedar* may derive by raising land productivity will, therefore, be offset by the loss of income from loans. In addition, the *jotedar* forfeits the political power which his tenants' dependence on his credit promotes. Hence, where land and credit markets interlock, relations of production prevent investment in new technology[57].

Once again, the assumptions of this argument seem far removed from rural realities. In the absence of sufficient empirical data from the nineteenth century, our criticisms are based on two recent surveys of eastern India and West Bengal[58].

57. Amit Bhaduri, "Agricultural Backwardness under Semi-Feudalism". *Economic Journal*, vol. LXXXIII, No. 1, (March, 1973), pp. 120-137.

58. Ashok Rudra, "Loans as a Part of Agrarian Relations. Some Results of a Preliminary Survey in West Bengal". *Economic and Political Weekly*, vol. 10, No. 28 (12, July, 1975), pp. 1049-1053; (based on a sample of 81 villages, 1971).
Pranab Bardhan and Ashok Rudra, "Interlinkage of Land, Labour and Credit Relations. An Analysis of Village Survey Data in East India". *Economic and Political Weekly*, vol. 13, (Feb. 1978), pp. 367-384; (based on a random sample of 275 villages in 1975-76).

Credit transactions between jotedar and tenant are of two kinds. Loans are advanced for production to help sharecroppers meet their costs. In West Bengal, 44% of tenants take production loans from landlords. Far from carrying extortionate rates of interest, 23% of such loans were interest free (40% in the original survey)[59]. Among landlords, 64% shared the cost of production with their tenants, and 77% of these landlords took decisions singly or jointly with their tenants about crops and inputs[60]. Such evidence does not square with the stereotype of the parasitic landlord. As the authors point out, "Production loans as well as cost-sharing obviously indicate a strong interest on the part of the landlord in productive investment on the tenant farm"[61]. Moreover, the high percentage of interest-free loans hardly supports the theory that the jotedar regards usury as his primary source of income.

Similarly, consumption loans do not always carry interest for the jotedar. In West Bengal, 51% of tenants take consumption loans from their landlords, but 45% of such loans are interest-free[62]. Even those loans which

59. Bardhan and Rudra, op. cit., Table 6, p. 371. Rudra, op. cit., Table 2, p. 1050.

60. Bardhan and Rudra, op. cit., Table 7A, p. 371, Table 9, p. 375.

61. ibid. p. 375.

62. ibid. Table 3, p. 369.

are repaid with interest do not necessarily enrich the _jotedar_. Most consumption loans are paid in kind and repaid in kind after the harvest. Typically, the tenant repays twice the grain borrowed. From the tenant's point of view, the rate of interest is thus 100%, but from the vantage of the _jotedar_ who lends when rice prices are high and is repaid when prices are at their lowest, the money rate of interest may be only just sufficient to cover the market price of the original loan. The rate of return on his capital may well be nil[63].

It is ahistorical to rely solely on contemporary evidence to disprove the theory of the parasitic landlord. Yet even from the 19th century evidence it is abundantly clear that _jotedars_ did not use credit as a means of controlling production. In particular, there is no causal link between credit and the spread of commercial crops. Such a system of debt peonage is incompatible with the remarkable sensitivity of jute growers to changes in price. If landlords _qua_ moneylenders had forced producers to grow commercial crops, then price would not have been a major determinant of the area under jute. In fact, the supply elasticity (the ratio of the percentage change in

63. Keith Griffin, _The Political Economy of Agrarian Change. An Essay on the Green Revolution_. (London, 1979, 2nd edn.), p. 91.

area cropped to the percentage change in price) of jute between 1890-1914 in Bengal was positive.

Table 4.5

SUPPLY ELASTICITIES OF AGRICULTURAL PRODUCTS IN BENGAL AND SELECTED COUNTRIES BEFORE 1914

Country/region	Period	Crop	Elasticity
Bengal	1890-1914	Jute	0.380-0.940
Bengal	1890-1914	Rice	0.095-0.223
America (N & E)	1867-1914	Wheat	0.029-0.234
America (South)	1882-1914	Cotton	0.099.-0.321
Hungary	1892-1911	Wheat	0.080-0.130
Hungary	1892-1911	Rye	0.180-0.690

Source: Akbar Ali Khan, Some Aspects of Peasant Behaviour in Bengal, 1890-1914: A Neo-Classical Analysis, (Ph. D. 1979, Queen's University), p. 140. Table 5.3.

Indeed, the supply elasticity with respect to price for jute in Bengal was much higher than that of wheat in northern and western America, cotton in the American south, and wheat and rye in Hungary. While the highest regional elasticity of any agricultural product in late 19th century America was 0.321, the lowest regional price elasticity of jute in Bengal during the same period was 0.38. Jute growers in Bengal were, therefore, much more sensitive to price than their contemporaries in the U.S.A. This need hardly surprise us, since high-productivity agriculture is characterised by the substitution of expensive machines for labour and often greater technical skills. Such rigidities make the switch to a new crop much more costly than in a low-productivity agriculture such as Bengal[64]. The short-term response to price in Bengal is therefore likely to have been high. This naturally controverts the theory of parasitic landlords employing credit as a coercive mechanism to grow jute.

As if this were not enough, the qualitative evidence confirms that the markets for credit and jute did not interlock. In the Forth Valley, production decisions were not always made by farmers. Many paid all or part of their rent in kind, which narrowed the producer's choice of crops considerably. On the Grahams of Airth estate as late as 1800, 67% of the tenants' gross rental continued to be paid in kind (See Section 3 above). Moreoever, many Scottish farmers held leases which legally bound them to observe specific crop rotations[66]. Insofar as rents were paid in kind and farmers followed fixed rotations, production decisions were made by the landlord. By contrast, in Bengal production decisions were largely made by the producers themselves.

64. John W. Mellor, Agriculture in Economic Development. (Ithaca, 1966), pp. 198-199.

66. NSA, vol. 8, p. 15, (Falkirk).

"It is suggested that the cultivators as a class are financed in some peculiar way for the cultivation of jute", remarked one Dacca official. "This is not the case. I doubt if one cultivator in 1,000 is dependent in any way on the aratdar, bepari, or jute merchant for loans and advances. The experiment has been tried in this district, but has been definitely abandoned by bepari and jute merchant alike. The cultivator is indebted, but his indebtedness is not associated specifically with the cultivation of jute; in fact, his indebtedness must encourage him to cultivate jute at a large profit in order to pay off the interest due to the mahajan"[65].

And profits were large. In Dacca, "... the raiyat makes a very large profit from his jute crop... I have been assured by the head of one of the largest jute firms in Narayanganj that the price received by the cultivator from the aratdar or bepari, and the price paid by the jute merchant to the bepari, seldom differs by more than Re. I per maund, the raiyat will receive Rs. 13. It is impossible to prove these figures as the raiyat does not and cannot know the real market price of the staple; but at the same time, every hat or bazaar has its current prices or market rates. The raiyat is in a position to bargain with the

65. BRP, (Agriculture), vol. 9386, (August, 1914), No. 25. F. D. Ascoli, Settlement Officer - Secy. Govt. Bengal Revenue Dept., 27 April 1914.

aratdar or _bepari_, with the result that a very fair market price is arrived at. From my own enquiries, I have found that the _raiyat_ last year seldom received less than Rs. 10 to Rs. 12 per maund for his jute: at the end of the last jute season, it was Rs. 14 or Rs. 15. This increase in the price paid to the cultivator was practically constant, and a comparison with the market rates will show that the profit of the cultivator increased with the rise in the market rate"[67]. It is clear that _raiyats_ did, in fact, receive the profits from commercial crops to which they were legally entitled.

This is not to deny that moneylending was an important source of income for _jotedars_. Usury was universal, and each cultivator was normally indebted to several moneylenders simultaneously[68]. The volume of debt in Dacca district in 1900 was so large that annual interest payments were estimated to be over five times the total amount paid to landlords as rent[69]. In such conditions, it seemed logical for British officialdom to conclude that the returns from moneylending were so high that _jotedars_ had no incentive to invest capital in improving agriculture.

67. _BRP_, (Agriculture), vol. 9386, (August, 1914), ibid.

68. Jack, _Economic Life_, p. 97.

69. Ascoli, _Settlement Report_, p. 47.

> "Profits from moneylending are so great and the return is so sure that as soon as a man is in a position to invest money, he at once lends it out at interest and thereafter keeps it out at interest... As long as money is so easily made by moneylending, it will be difficult to get men of capital to take to farming. The successful cultivator who makes money also very soon becomes a moneylender"[70].

But this argument is misconceived. High returns from moneylending are not the cause of low agricultural productivity, but the result. High interest rates are a function of low incomes, which create both a disproportionately large demand for capital and a generally inelastic and limited supply of capital[71]. Where incomes are low, there is little surplus for saving and for the accumulation of funds to make agriculture self-financing: the cultivator in Dacca district was "compelled to pay 25 per cent of his net income for the use of agricultural capital"[72]. Moreover, transaction costs are high because loans are small: fixed handling charges are, therefore, relatively large and there is a bigger risk of default. The solution is investment to raise agricultural productivity and thus create additional income. This in turn would lower interest

70. Royal Commission on Indian Agriculture, vol. IV, p. 433. Evidence of Mr. James Peddie, ICS Magistrate-Collector-Malda.

71. U Tun Wai, "Interest Rates outside the organised Money Markets of Underdeveloped Countries". Staff Papers of the International Monetary Fund, vol. VI, (1957-58), p. 108.

72. Ascoli, op. cit., p. 47.

rates by reducing the demand for capital[73]. As evidence, it is generally accepted that interest rates are lower in areas of commercial agriculture[74]. Rather than inquire why interest rates were high, we must ask why the marginal productivity of capital invested in agriculture was so low.

Neither in their choice of tenancy or in their use of capital for moneylending, can Bengal landlords be described as parasitic. In terms of economic rationality, their behaviour was no different from that of landlords in the Forth Valley. Both adopted systems of tenancy which offered the most efficient managerial control within the operating constraints of two very different agricultures. Both the jotedar and the laird owned land whose rent was determined by market forces and both were equally determined to squeeze the full market rate from their tenants. Indeed, by this criterion, Bengal landlords were far less parasitic than their Scottish counterparts.

Rents appear to have followed prices closely until 1790 and to have overtaken them during the Napoleonic Wars. Thereafter, until 1840, they were well ahead, (Tables 5.4 and 6.19 above). Rent in Scotland appears to have been the

73. U. Tun Wai, "Interest Rates", pp. 80, 107-109.

74. Subrata Ghatak, "Rural Interest Rates in The Indian Economy". Journal of Development Studies, vol. XI, No. 3, (1975), pp. 190-201.

stick with which landlords forced their tenants to adopt new agricultural techniques. "Our farmers are more squeezed and bear squeezing better than their English neighbours", wrote one factor to his landlord, Sir John Sinclair, "and for the very reason that sheep submit quietly to be shorn; because of their weakness..."[75].

No comparable 'squeeze' was evident in Bengal. One observer wrote in the 1870's:

> "In the course of the enquiries I have made... I have been struck with the large proportion of the gross produce which falls to the share of the cultivator of the soil in many parts of this district; and although the position of the Bengal ryot is generally supposed to be analogous to the miserable cottier tenants of Ireland, yet the result of my investigations shows that far from any such analogy existing here, the peasantry of Eastern Bengal hold their lands on much more favourable terms than the Metayers of France and Italy..." [76].

75. Thurso East Mss III f. 319, quoted Rosalind Mitchison, Agricultural Sir John; the life of Sir John Sinclair of Ulbster (London, 1962), p. 211.

76. BRP, vol. 338. (January, 1874), pp. 44-45. J. G. Charles offg Joint Magistrate-Collector of Dacca, 19th Sept. 1873. Report on the origin, nature and probable consequences of Agrarian combinations in Eastern Bengal with special reference to the Sub-Division of Moonshigu nge.

A generation later, the position was unchanged. In Dacca in 1900, the rental income of the landlord classes amounted to only 6-1/4% of the gross value of the agricultural produce of the district. As the Collector remarked, "It is obvious that, whatever may be the defects in the economic position of the cultivator, it is not due to the effects of landlordism, and... the proportion of the agricultural wealth of the district that accrues to the landlord is relatively small"[77]. This made investment relatively more difficult for the Bengal landlord. It hardly supports the theory that he was inherently parasitic.

In sum, Bengal jotedars were just as rational as Scottish landlords save in one crucial respect: they were unwilling to provide capital for innovation.

77. Ascoli, Final Report, p. 44.

Section 3: capital formation

In the Forth Valley, unlike Bengal, a significant proportion of the economic surplus was reinvested in raising agricultural productivity. This process of landlord capital formation was studied on three estates in the region. A case study approach has obvious pitfalls, but until more collections of private papers are studied in detail, questions about the rate of capital formation in Scottish agriculture cannot be answered in general terms. Moreover, our examples have the merit of illustrating the range of landholding in the Forth Valley.

This difference is expressed by the relative strength of their rent-rolls in 1770. The estate of the Duke of Montrose had a gross rental of £4,500; the rental of the Stirlings of Keir was over £1,000; finally, the annual rental of the Grahams of Airth was about £800., (See Appendix H). In terms of our earlier classification based on incomes, the Duke of Montrose represents the aristocracy (£4,000 plus), the Stirlings of Keir, the wealthy lairds ($1-2,000), and the Grahams of Airth, the middling lairds (£500-1,000). Our case studies thus deal with three of the six social groups of landlords found in the Forth Valley, which between them controlled 40% of the agricultural surplus. Great landlords, lesser and 'bonnet lairds' are not represented.

Capital formation is conventionally measured in two ways, according to the type of investment. However, eighteenth-century estate accounts do not distinguish between fixed capital formation, i.e., additions to the existing capital stock, and gross capital formation which includes investment for repairs and maintenance. This does not reflect a lack of commercial sense, but common accounting practice: factory accounts in the manufacturing sector did not draw the distinction either. As a result, it is virtually impossible to separate fixed capital formation from other expenditure, unless the accounts are specific. This proved possible in one case, the estates of the Duke of Montrose. For comparative purposes, therefore, our estimates refer to gross capital formation unless otherwise specified, (Appendix H).

(a) The Montrose estate.

The Duke of Montrose, Marquess of Graham, Earl of Kincardine, Viscount of Dundaff and lord of Aberuthven, Mugdock and Fintry, was the biggest landowner in the Forth Valley. The surviving estate accounts cover the period 1740-1770, the reign of William Graham, the second Duke.

William inherited an estate run on traditional lines. His father James, the first Duke, had entrusted the estate to a relative, Mungo Graeme of Gorthie (b. 1682 d,). while he followed a political career. Gorthie's management was paternalist rather than commercial. "In his time" wrote a neighbour, "the Montrose estates, both Highland and Lowland, was held, at what was then accounted moderate rents, by persons exceedingly attached to the family, who could boast of having stood by it in trying perturbed times"[78]. Loyalty to the lord came before profit. "I have heard it said that in Gorthie's time, the Montrose rents were sometimes very ill paid... Lenity and forbearance may be carried too far". In the 1740's, the accounts show about 15% of the rental went uncollected. William's first appointment was of a less lenient factor. Under the new management of Graeme of Orchill, Gorthie's successor, the estate was reportedly run like "clockwork".

William's second task was to centralise his sprawling estates. As his title suggests, they were the result of years of haphazard accumulation through inheritance and purchase. His father had fallen heir to the earldom of Airth and the Barony of Drymen in 1694 through the death of the Earl of Menteith[79]. The estate of Lennox and Darnley had been bought from the Duke of Lennox and Richmond in 1703. The second Duke embarked on a programme of consolidation. He sold the family house in Glasgow and began to

78. Ramsay of Ochtertyre, Scotland and Scotsmen, vol. 2,p. 297.

79. Sir James Balfour(ed). The Scots Peerage, (Edinburgh, 1909), vol. VI, p. 261.

improve the policy of the ancestral estate at Buchanan, transforming what was little more than a country house into a mansion "surrounded by a lawn and pleasure ground of more than 1,500 acres, bearing a nearer resemblance in its extent, and in the disposition of its embellishments, to an English park than anything that is to be met with in Scotland"[80]. Buchanan was henceforth the family seat. "It became his settled policy to concentrate his estate in that neighbourhood, and with this object he sold the property lands of Lennox, the whole lordship of Darnley, and lastly, in 1770 , the ruined castle and remaining property lands of Kincardine, buying in place of them lands in Stirlingshire"[81]. This is borne out by the estate accounts which show that Buchanan accounts for 50% fixed capital formation in the 1740's and 1760's.

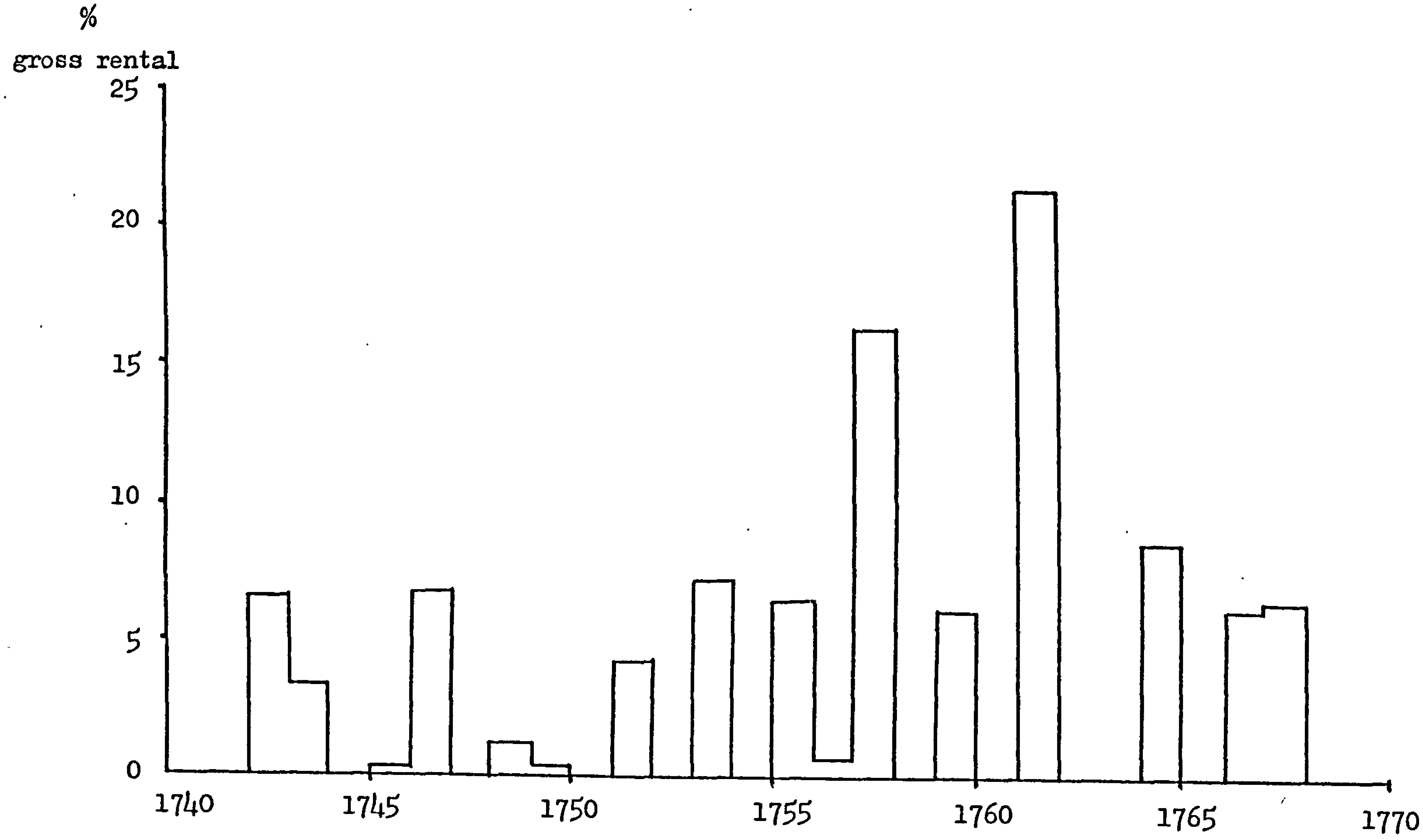
Gross capital formation is difficult to compute for the Montrose estate because of the numerous land transfers. In addition to those mentioned above, miscellaneous purchases added £150 to the rental in 1744; and £560 in the 1750's. The rates shown in Figure 4.5 represent the combined totals of the five separate properties of Buchanan, Menteith, Mugdock, Lennox and Kincardine. Gross capital formation in the 1740's was low, at less than 3% of gross

80. Graham, General View Stirlingshire, p. 74.

81. The Scots Peerage, vol. VI, p. 268.

Figure 4.5

Capital formation in the Forth Valley: Duke of Montrose's estate 1740-1770



rental. By the next decade, it had doubled to 5.84% and by the 1760's, was running at 10% of annual rental. Although the increase was significant, it was nowhere near the scale experienced on smaller estates, like Keir. An explanation may lie in different types of land use. Upland parishes like Buchanan were improved by conversion from arable to pasture, thus avoiding large capital outlays on enclosure, farm buildings and drainage. All the improved farms in the parish in 1790 were under grass and small farms had been amalgamated for specialisation in sheep farming[82].

(b) Stirling of Keir estate

Capital formation at Keir between 1760 and 1800 was the work of three successive heirs and spanned two generations. All were the sons and grandsons of James Stirling (succ. d. 1749), who had no less than twenty-one children, fourteen of them male. Whereas in Bengal the estate would have been divided equally among the heirs, in Scotland primogeniture ensured it stayed intact by passing to the eldest son. Without land of their own, younger sons sought traditional path to riches through trade.

82. <u>OSA</u>, vol. IX, p. 200, (Buchanan).

Archibald Stirling left for India in 1735. In his farewell letter, he promised his father, "as for my part, I do assure you that if it happens I should make a fortune (which I don't in the least doubt of for there shall be neither industry nor application wanting), I shall always be ready to assist the rest of my Brothers to the Utmost of my Power..."[83]. His optimism was soon justified. "At present", he wrote in 1742, "I reckon myself worth £4,500 sterling and the voyage I am now going on will I expect improve my fortune a thous. or twelve hund. pounds, as soon as I have muster'd up Eight thous. I propose coming home...[84]. But the temptation of wealth proved irresistible. Four years later, Archibald informed his brother, "I have by this conveyance remitted home about £1,200 and by the next oppurtunity propose remitting him about £4,800... which with the diamonds sent home last year will make up a sum of £8,000... or thereabouts, which I look upon as a nest Egg, for I must say, property seems to be in a mighty fluctuating condition with us at present"[85]. Despite the temporary uncertainty, Archibald wrote again the following year that he "expected to add to my fortune by next year as to be worth £17,000 with which I am determined to be satisfied"[86]. When he finally arrived in

83. Stirlings of Keir and Cawder Muniments, Strathclyde Regional Archives, Archibald Stirling-John Stirling, 9 Dec. 1735, T-SK 11.2.17.

84. ibid, 25 Oct. 1742, T-SK 11.2.24.

85. ibid, 30 nov. 1746 T-SK 11.2.29.

86. ibid. 20 Feb. 1747, T-SK 11.2.32

England in 1748, he was worth £18,000[87].

Not all younger sons were so fortunate. Henry Stirling followed his elder brothers footsteps to India. As Archibald explained to his father, Henry was being sent to Bengal, "so that we may trade jointly together", and held out high hopes, "as he is young he can't fail of making his fortune if he lives"[88]. His career began well and by 1742 Henry Stirling was Resident at Sillibar. Six years later, he was dead of fever. As a fellow-countryman wrote, "this climate soon exhausts a person's health and strength, though ever so firm in constitution, as is visible in every countenance, after being here twelve months"[89]. Only 43% of the East India Company's employees in Bengal between 1701 and 1775 returned home alive[90]. Despite the family's loss, Archibald was joined by another member within a year. Business came first and his father saw the necessity for partnership: with "no relation on the spot, it is hard for them to extend their credit as having no body to prevent the embezzling of their efforts and to see their debts paid in case of death"[91].

87. ibid, 21 Feb, 1748, -SK 11.2.37.

88. ibid, 13 Dec. 1735, T;SK 11.2.19

89. Fleming Martin, "An Account of the heat of the climate of Bengal". Philosophical Transactions, vol. LVIII, No. XXV, p. 219.

90. P. J. Marshall, East Indian Fortunes; the British in Bengal in the eighteenth century.(Oxford, 1976), pp. 218-219, Table III.

91. Keir Muniments, James Stirling-John Stirling, 25 Dec. 1735, T;SK 11.2.20.

Archibald's fortune was not yet secure, since it had still to be profitably invested. "Were the money mine, his brother John advised, I would put it into no publick fund in Europe, for the state of affairs in most Countrys here have a very gloomy & dark aspect, what the end will be God alone knows, but this you may depend upon that the private Credit of Scotland will feel the effects of any Event less than the publick or even private Credit of any other Country..."[92]. On Archibald's return, he wrote again in the same vein. "I desire you for Godsake to be cautious of putting your money in the Publick funds, for let the Londoners say what they will, Down these stocks will come some morning when least expected, and involve all concerned, in the same Catastrophy the South Sea did in the year 1721, for all the definitive Treaty, is in no such condition as to encourage any person to risque their fortune on that Bottom"[93].

His brother's warning struck home. Money which Archibald had earlier remitted to Britain was already being used to improve the family estate. "What money you incline to remit to Britain, wrote John, "I shall very willingly take charge of it at 4-1/2 per centum per annum of interest, and I design in the first place to apply it to the Payments of my own Debts in the next place to the making of some

92. ibid, John Stirling-Archibald Stirling, 15 May, 1747, T-SK 11.2.35.

93. ibid, Nov. 7, 1748, T-SK 11.2.47.

little Purchases here of Lands that ly convenient & whats over to lay it out on good security to the best advantage, the sum I would want to pay my debts and make these purchases is £6,000 or 8,000 ster, to what I owe you already that is to say in all betwixt £8,000 - 10,000 sterling"[94]. Archibald accepted the offer, although expressing pained surprise at the low rate of interest. "I must confess, I expected you would have allowed me an interest of 5½%, for by advices from England, I understand that the late Publick loans yield full that, & indeed it is but reasonable to think so, considering the yearly supply, amounting to Eight Millions, however, we shall not dispute about that, & when we meet I shall very willingly place in your hands the sums you desire... providing we can agree upon terms"[95].

Archibald's terms were no less than half the family estate. His brother Robert wrote from Jamaica to "congratulate you on the purchase you have made of Cadder from Bro. John which I sincerely wish may turn out to your expectations & that you may spend the rest of your days with that Ease & Tranquillity which every good Man desires"[96]. Meanwhile, John Stirling put the £8,000 he received from the sale to good use. He "was among the first landlords

94. ibid, 15 May, 1747, T-SK 11.2.35.

95. ibid, Archibald Stirling-John Stirling, 4 Feb. 1748, T-SK 11.2.37.

96. ibid, Robert Stirling-Archibald Stirling, 12 March, 1750, T-SK 2.68.

Figure 4.6

Capital formation in the Forth Valley: Stirling of Keir estate 1764-1800

in the Forth Valley to practise "the English husbandry"[97]. His achievements as an improver included the foundation in 1752 of Stirlingshire's first commercial dairy, which produced butter for the Edinburgh market[98].

When John Stirling died childless in 1757, Archibald inherited the estate. Like his brother, he was an energetic improver. "The late Archibald Stirling of Keir", recorded the Statistical Account, "and most of the other proprietors, at the end of the last leases, inclosed and subdivided, built neat steadings of houses in centrical places, and covered them with tiles or blue slates"[99]. William, who succeeded Archibald in 1783, and his son, Archibald (succ. 1793 d. 1847) reaped the benefits of these investments.

(c) Graham of Airth estate

Not all families were so fortunate in locating sources of capital. For the smaller gentry or lairds like the Grahams of Airth, who constituted the majority of landowners in the Forth Valley, the debts they accumulated in the process of capital formation were a severe drain on their rents.

97. Ochtertyre, Scotland and Scotsmen, vol. 2, p. 245, note.
98. ibid, p. 251, note 1.
99. OSA, vol. XII, p. 685, note (Lecropt).

The estate of the Grahams of Airth had been acquired in 1717 by James Graham after a lucrative career in public service as Judge Admiral. The estate was already saddled with a debt of £11,500 when his son William inherited in 1746. He promptly embarked on a vigourous programme of improvements, and the overall debt showed only a slight decrease between 1755 and 1775[100]. Heavily in debt, and with fourteen children to settle, William Graham sent his sons abroad.

James, the eldest (succ. 1790 d. 1806), sailed for Bengal immediately he left school in 1780. Formidable problems faced the sons of families without powerful connections. "Every thing in this part of the world", wrote James to his father after his arrival in Calcutta, "depends as much upon Interest as it does in Europe, therefore, if you could make Interest for letters to the Governor here, or to Mr. Wheeler as also to any Gentleman who may come out as supreme Councillors, they might perhaps be the means of sending me sooner back to Britain than I shall in all Probability come if I keep my health in this Country"[101]. James's search for patronage is a constant refrain in his letters (begging his father not "to let

100. Grahams of Airth Papers, Scottish National Library, Ms. 10851.

101. ibid, Ms. 10920, 1 May, 1781.

slip any Opportunity of forwarding ... my Interest ... by procuring letters to any body who may come out to this Country in a high Station..."), and ultimately ended in disappointment. "Lord Cornwallis arrived the 13th and I was introduced to him, but was not a little disappointed not to have had letters to him from the General who promised to write in my favour if ever the Event of his lordship's coming out to this Country should take place..."[102].

James had to be satisfied with appointments befitting his family's modest status. "I have been for some time past appointed Deputy paymaster to the detachment commanded by my shipmate Sir John Cumming for which my friends Mr. Alexander and Colonel Kyd merit my warmest acknowledgements, as it was by their Interest alone that the Appointment took place and as it is reckoned to be a pretty good thing it is to be hoped that in a few years I may be worth a few hundreds"[103]. Interest also lay behind Graham's entry into the civil service in 1786, when he was appointed assistant to the Collector of Rungpur. The Collector was Hort Day McDowall of Castle Semple. Of this appointment, Graham wrote that "though my Emoluments are but small I think myself very pleasantly situated and hope

102. ibid, f. 73, 17 Sept. 1786.

103. ibid, f63, 7 Oct. 1783.

the time is not far off when I may do something for the beginning of my Fortune"[104]. His career in the Bengal judiciary subsequently saw postings to Purnea and Midnapur and he ended twenty years service as fourth Judge of the Provincial Court of Appeal and Court of Circuit in Dacca.

Graham's motives in going abroad were purely financial. "My views, he later wrote, "when in the year 1780, I embarked for India were confined to the objects of paying off the incumberances on my family estate and of paying some attention to a provision for my unmarried sisters..."[105]. Throughout his career in Bengal, he was kept closely informed by his father of the course of improvements on the estate and remained keenly aware of his family responsibilities. "I heartily wish that your Plan of Enclosing your Salt Greens may succeed according to your desire", he wrote his father in 1783, "& make no doubt but that they will soon pay the Expence of it, as your neighbour Lord Dunmore has succeeded so well. I'm truly sensible of the Efforts you have been obliged ot late to make to settle us creditably in the World, and hope that you will soon have the satisfaction of seeing us all turn

104. ibid, f. 73, 17 Sept. 1786.

105. ibid, f. 145. n.d.

out worthy of the Education you have given us..."[106]. His gratitude took the tangible form of periodic remittances, none very substantial. "I hope my line of life in this country will enable me to make a small addition to your yearly income, and as I owe everything to you, I consider whatever Fortune may throw my way as to be but your due"[107]. Graham's appointment to Rangpur was followed by a remittance of £150 ("as you seem a little distressed for Money"), "which if I'm lucky may be continued to you every year and by that means you may not be under the necessity of parting with Airth where you & my Mother have been so many years happy in your family..."[108]. Unfortunately, we do not know the size of Graham's fortune when he returned in 1803.

We know, however, that he fulfilled his obligations to his family. When he succeeded his father in 1790, he did not return immediately, since he had seen only three years service in his first appointment. Instead, he entrusted his inheritance to his mother, offering her twenty-nine acres of land rent free to induce her to stay at Airth "for the preservation of the House and Policy"[109]. Before his return, he had granted his mother a yearly annuity of £50 and bestowed annuities of £25 to each of his unmarried

107. ibid, f. 81, 20 July, 1787.

108. ibid, f. 73, 17 Sept. 1786.

109. ibid, MS.10801, f. 255.

sisters, together with a dowry of £500 in the event of their marriage[110].

James was not the only member of the Airth family to try his fortune in Bengal. His brothers, Thomas and Henry were both sent out soon afterwards. James advised his father on their careers. "I have consulted with Mr. Alexander concerning my Brother Tom's coming out to this country he advises that unless you can get him appointed in the Coy's Service you should by no means send him out as there have been a great many Riffs of late Crept into the Army in this Country..."[111]. Instead, Thomas Graham worked his way up from midshipman to Captain of an East Indiaman. Nothing is known of his fortune, but the Captaincy of an East Indiaman was a privileged position and many became rich after a single voyage. A third brother Henry, was bought a commission in the Bengal army, but he died of fever in 1787[112].

James Graham continued the policy of improvements begun by his father. The 1790's saw capital laid out on repurchasing feus which made up about 10% of the area of the estate, and the houses and yards of the tenants, in

110. ibid, Sederunt Books, 15 June, 1802.

111. ibid, MS.10920, Dec. 29, 1781.

112. ibid, f.85, 7 Nov. 1787.

what was obviously an effort to create fields large enough for enclosure. Land bordering the estate was bought for the same reason: "was you to get the Loch's (farm) it will Square your Estate very neatly on that side", wrote the factor[113]. Thomas, the East Indiaman, who succeeded his brother in 1806, improved the estate considerably before his death in 1832. Rebuilding on an extensive scale took place from 1810 onwards. In 1818, the grieve at Airth reported that "you have at the same time Masons, Carpenters, Millwryghts & Slaters. Masons building at that part of the Stacks which forms part of the Poultry yard. Carpenters preparing the Barn flooring. Millwryghts putting up the House or outer Wheel of Thrashing Mill. Slaters done with the Barn about to commence to cover up and lay Houses..."[114]. This process of capital formation is shown in Fig. 4.7.

Although the estate accounts cover an entire century, (1730-1830), they do not give a breakdown of expenditures which would allow us to estimate capital formation. Rates of capital formation had to be reconstructed from miscellaneous sources, chiefly the estate receipts, covering the fifty years between 1770-1820[115]. Three years for which rentals were available were selected from each

113. <u>ibid</u>, Ms10865, f. 265.

114. Ms10875, f.9.

115. MSS10880-10884.

Figure 4.7

Capital Formation in the Forth Valley: Graham of Airth estate 1730-1830

decade. The results show an extremely uneven pattern of investment with improvements proceeding in fits and starts as funds were built up. The relative magnitude of the capital required is indicated by their high proportion to gross rental in individual years (1800, 1809).

The links between metropolis and colony illustrated by the family histories of the Stirlings of Keir and Grahams of Airth are by no means unique. Other estates in the Forth Valley had close connections with Bengal. Seton of Touch, a merchant who married an heiress, was of the same generation as Sir John Stirling of Keir and his partner in improvement. His eldest son, Archibald rose to become Commissioner of the Ceded Provinces[116]. The sons of the lesser lairds were also prominent. Buchanan-Hamilton of the Buchanans of Leny and Arnprior and one of our best sources on Bengal agriculture, returned with a modest fortune which he at once used to embellish his family estate[117]. Nor was this new source of wealth monopolised by landowners. Ramsay of Ochteryre divided those buying land in Stirlingshire into three classes: profiteers who had done well out of Government contracts and prize

116. George Seton, A History of the Family of Seton, (Edinburgh, 1896), vol. 1, pp. 346-347.

117. Robert Chambers. A biographical dictionary of eminent Scotsmen, (Glasgow, 1835), vol. 2, pp. 395-396.

money in the Napoleonic wars, tobacco merchants, and adventurers returning with fortune from the East Indies. Jamaica was an equally or even more prominent source of foreign capital. Archibald Stirling of Keir (succ. 1831 d. 1847), made a fortune as a planter, and no less than three of Sir John Stirling's sons were Jamaica merchants. Similarly, the Grahams of Airth had interests in Jamaica through marraige into a cadet branch of the Stirlings of Keir, the Stirlings of Ardoch.[118]

That colonial fortunes should be invested in land is hardly surprising since it was the absence of a landed income which drove younger sons abroad. Among these, the sons of small landowners predominated. "Everybody in this part of the world, wrote James Graham, "who knows anything of Seton's connections at home is much surprised that his father should ever have agreed to his coming to a Country which is commonly the Resort of Gentlemen whose fortunes will not keep them at home"[119]. In this connection, we note that although the Duke of Montrose owned £700 of East India stock and was willing to exert his patronage to place his friends in the Bengal army, he had no relatives

118. William Fraser, <u>The Stirlings of Keir, and their family papers</u>, (Edinburgh, 1858), pp. 72-73, 81.

119. <u>Airth Papers</u>, MS10851.

in Bengal.[120] Finally, one link between several families with colonial connections is their loyalty to the Stuarts. Both the Stirlings of Keir and Buchanans of Leny had their estates confiscated after participating in the rebellion of 1745, while James Graham, Judge Admiral, was among the friends who bought Keir for Stirling's son when it was sold by the government. Since entrance to the professions required an oath of allegiance to the Hanoverian crown, their younger sons had often no choice but to turn abroad for employment.

Colonial capital is unlikely to have been important in financing the agricultural revolution, if the experience of landowners in the Forth Valley is any guide. Admittedly, since the region was predominantly one of small lairds, a disproportionate number had younger sons in Bengal. For such families, foreign capital may have been significant at the margin. But there was little shortage of domestic capital. One small laird, the elder James Graham of Airth, had debts of £11,664 sterling, of which less than 35% was formal banking credit. The rest came from twenty-six individuals with credit ranging from £1,000 (Oliver Holt, Esq.), to £50 (Thomas Hamieson, coachman),[121]. These small creditors were like the shareholders in a modern company. The debts of an estate were not a sign of weakness but an expression of the confidence of investors in the security of landed property. Their readiness to invest kept the real rate of interest low.

120. Montrose Muniments, ED 220/5, 934(2); 14 April, 1748. ED 220, 119, p. 8.

121. Airth Papers, MS. 10920, 24 Sept. 1782.

Generally, zamindars played no such role in improving agriculture. Nevertheless, some zamindars fulfilled the highest expectations of the Permanent Settlement. The best knows example is Jaykrishna Mukherjee, zamindar of the Uttarpara estate in Hooghly district, west Bengal.

Capital formation on the Utterpara estate affords a direct comparison with the Forth Valley. Since Jaykrishna's accounts do not survive, our estimates must be reconstructed from odd figures and can only be approximate. By the 1850's, the Utterpara zamindari covered some 400,000 bighas or over 130,000 square miles centered on Hooghly, but sprawling over the neighbouring districts of Midnapur and Burdwan[122]. We have estimates of capital formation spanning the years before 1880:

Capital investment		Cost
Embankments	Rs.	85396
Tanks		102182
Total capital formation		187578
Total capital expenditure		552739

Jaykrishna's gross rental income was about Rs. 750,000 or £50,000 a year, or about five times that of the Duke of Montrose, the biggest landlord in the Forth Valley[123]. However, half of this was paid as revenue and

122. Mukherjee, Bengal Zamindar, p. 91.

123. ibid, p. 436.

rent to his superior landlord, the Maharaja of Burdwan. Over the period 1840-1880, therefore, Jaykrishna's average net income was in the region of 15 million rupees. This figure represents the rental demand, not the amount normally collected. Most <u>zamindars</u> only collected 75% of their nominal rent-roll[124]. This brings net income down to Rs. 11,250,000. Given a total capital expenditure of Rs. 752,739, the average annual rate of capital formation on the Utterpara estate was 6.69%. This bears comparison with the rate of capital formation on the largest estate in the Forth Valley belonging to the Duke of Montrose.

Jaykrishna was clearly not a parasitic landlord. Aspects of his career reveal striking similarities with the behaviour of landlords in the Forth Valley. Jaykrishna invested in land for the same reason as the returning merchant, Alexander Stirling of Keir. Like Stirling, his capital was accumulated outside the agricultural sector during service with the East India Company. "My father and myself, having lost large sums of money in 1831/2 by the failure of the 4 leading houses of agency in Calcutta,

124. <u>Report of the Government of Bengal on the Bengal Tenancy Bill, 1884</u>. (Calcutta, 1885), vol. 2, p. 217. H. J. S. Cotton, Offg. Commr. Chittagong Division - Secy. Govt. Bengal Revenue Dept., 10 July, 1884.

we determined to invest the remainder of our capital chiefly in land tenures...[125]. Investment in land was thus a decision made on economic grounds with the expectation of security.

Again like Keir, Jaykrishna sought to maximise these returns by innovative management. Jaykrishna was no absentee, but personally inspected every property he bought and embarked every year on a tour of his estates. His rents were set by economic criteria. All land on his estates was carefully measured and rentals determined by the fertility of the soil. Again, management was centralised. Middlemen were bought out and the rents collected by a salaried staff under Jaykrishna's personal supervision[126].

Like improvers in the Forth Valley, Jaykrishna experimented with new farming techniques. He introduced new crops like the potato and kept a demonstration farm on his home estate. He was an active member of the Hooghly branch of the Agri-Horticultural Society of India, was

125. Mukherji, op. cit., p. 44.

126. Contrary to belief, this was not exceptional. Of the 477 large zamindari estates in Jaykrishna's district, no fewer than 277 were under direct or khas management. Bengal Financial (Statistics) Proceedings, vol. 181, (1873). F. H. Pellew, Offg. Collector of Hooghly - Commr. Burdwan Division, 12th June, 1873, para. 27.

closely involved with staging the agricultural exhibition in Burdwan in 1864-5. In 1881, he was elected to the Council of the Society where he sat on committees and served as Vice-President. He even published a book entitled Agriculture in Bengal, (1881).

Jotedars invested even more heavily in agriculture. Besides advancing credit for current production, they contributed to capital formation in several ways. First, they provided capital for extending the cultivated area, draining swamps and reclaiming jungle. This was generally done by advances or by leasing land rent-free for up to five years to encourage settlement[127]. The scale of such investment must have been considerable. Second, jotedars were the biggest single purchasers of agricultural land. Investment in land is frequently excluded from rural capital formation. But when jotedars saved to buy land, they consumed less of their income and thus made resources available to the rest of the community. There must have been corresponding net capital formation unless their action was offset by dissaving by others[128]. The volume of land sales in the period 1870-1914 was large, and in-

127. BRP, vol. 905, (1876). Colln. 14-71/72. D. R. Lyall, Offg. Collector, Davva - Commr. Dacca Div., 28 August, 1876. The costs of land reclamation were high: see BRP 237 (1875), pp. 100-101 for costs in the Sunderbunds.

128. This seems unlikely. One contemporary village study in Bangladesh shows net saving of 21% gross income (ie. minus dissaving by low income groups). M. Hubibullah, "Rural Saving and Investment in Developing Economy: A Case Study of an E. Pakistan Village". The Dacca Univ. Studies, vol. XVIII, (June, 1970). Table V, p. 33.

creasing. Some indication of the scale of the land market is given by the number of sales of occupancy rights, given for three of our four sample districts in the table below:

Table 4.6

TRANSFERS OF OCCUPANCY RIGHTS IN BENGAL, 1880-1914

(Rupees)

PERIOD	BURDWAN	DACCA	JESSORE
1881/2-1885/6	646840	305133	392874
1886/7-1890/1	1111585	845912	209792
1891/2-1895/6	2811904	2069981	441108
1896/7-1900/1	4555701	2949898	881105
1901/2-1905/6	4806368	3650667	1413960
1906/7-1911/2	7684077	n.a.	1551700

Source: M. C. McAlpin, Offg. Director, Dept. Land Records-Secy. Govt. Bengal Rev. Dept., 8-15th Nov. 1913, Bengal Revenue Procs., Sept. 1914, vol. 9389.

These figures underestimate capital formation since they take no account of land sales which were unregistered, nor do they show the amount of land mortgaged. (In Dacca in 1914, average value of land sales was Rs. 92 per square mile, while the average valuation of mortgage per square mile was Rs. 1157)[129]. The size of the land market in

129. BRP, vol. 9389 (1914), Nos. 44-45. M. C. McAlpin, Offg. Director Dept. Land Records, Bengal - Secy. Govt., Bengal, Revenue Dept. 8-15 Nov. 1913.

Bengal indicates a high rate of capital formation among jotedars.

Despite this, there remained a marked absence of investment in innovations to raise agricultural productivity. Many believed the explanation lay in the different attitudes of Bengal jotedars and Western landlords:

> "Of capital, there is not want; of labourers there is not want; of flocks and herds there is not want; but there is a want of improvement in everything. There is a want of a race of zealous, enterprising, professional Agriculturalists capable of seizing on all these natural advantages, and turning them to the best account"[130].

Bengal farmers were enterprising in the sense that they responded to price incentives as readily as Scottish farmers. Yet this does not imply that profit maximisation was their only or even their primary goal. Take our earlier example of an improving zamindar. By Bengal standards, Jaykrishna was an innovator, yet he remained firmly within the zamindari tradition. His concept of landholding was conventional. He claimed only zamindari rights and made no attempt to supplant the raiyats' rights of possession. The Collector of Hooghly wrote: "I have

130. Transactions Agricultural and Horticultural Society of India, vol. 5, (1838), Procs., p. 16.

never known a tehsildar in a khas mehal suggest that he could settle the question of rents by turning out a few tenants at will and introducing others who are ready to come. I have tried to impress on them the power they possess, but I have never seen it used"[131]. Fully one quarter of Jaykrishna's estate was occupied by tenure-holders who paid no rent at all[132]. That Jaykrishna did not challenge such rights was in keeping with his paternalistic view of zamindari. Naturally, this was very different from the behaviour of Scottish landlords. "Feudalism is now no more, it has disappeared before the spirit of commerce", ran one contemporary lament. "If landlords are not influenced by manners, by feeling for their species, immediate interest, in these days, points at their industrious tenants only as sponges to be squeezed"[133]. Such behaviour is also at odds with our expectations of rational economic behaviour.

Jotedars displayed a similar disregard for profit. Irrigation tanks were not always dug for economic reasons.

131. BRP, vol. 905, (1876). Colln. 14-68. W. Herschel, lately Collector of Hooghly. Note on proposed change in the substantive law of rent in Bengal, para. 5.

133. W. Ross, A Discourse upon the Removing of Tenants, (Edinburgh, 1782), p. 160.

132. Mukherji, Bengal Zamindar, p. 100.

"Bengalees in general consider that nothing is more praiseworthy than to make a tank... for the good of their fellow beings. This laudable idea arises from religious motives, and from a desire to propitiate the Deity. Hence, when a zamindar in this rural district has amassed a fortune, his first thoughts are turned to digging a tank, and no one who has not dug one, is esteemed a pattiot, or regarded as a big man...". In other words, tanks were status symbols and frequently of little economic value: "hence, it may be seen that a dozen tanks may be seen in some localities so closely huddled together as to the totally useless, and such could only have been dug by religious devotees, for the purpose of propitiation, or in ostentation by the rich zamindars, in the vain hopes of handing down their names to posterity". Many tanks were, therefore, never intended to be permanent additions to agricultural capital. "When once completed, the Bengalees take no kind of care of them, and very frequently, after the lapse of a few years, they become choked with aquatic plants, rank vegetation, and low jungle, which spring up in an incredibly short time... The Bengalee never re-digs an old tank, no eclat attaches to his doing so, he prefers to dig a new one"[134]. It is clear that

134. James Lind Sherwill, A geographical and statistical report of the Dinagepore District, 1863. (Calcutta, 1865), p. 4.

some tanks in Bengal were never intended as commercial investments yielding a return to the landlord. "The custom of the district", reported the Collector of Burdwan, "is that no raiyat pays for water and everyone whose field is within access of the tank has the right to take water from it without permission and without payment"[135]. Tanks were therefore more profitable for the *raiyat* than the landlord. Yet what one British official described as "the mania for tank digging" continued[136].

Of course, similar motives inspired some of the investment in agriculture by Scottish landlords. Much of the capital formation in infrastructure (public roads, canals, bridges) and rural housing (a mansion for the laird or cottages for his labourers) gave low rates of return and added little directly to agricultural productivity. Investment of this kind is perforce treated as part of capital formation, since it cannot be separated from other expenditure in estate accounts. This obscures the fact that, like the tanks of the Bengal *jotedar*,

135. *Proceedings, 2nd Annual Conference Board of Agricultural Dept. Bengal*, Dacca 1-2 Aug. 1921. (Calcutta, 1921). App. II, Subject 4, Irrigation Tanks, p. xi.

136. *Report of the Government of Bengal on the Bengal Tenancy Bill, 1884*, (Calcutta, 1885), vol. 2, p. 206. E. E. Lowis, Commr. Chittagong Div. - Secy. Govt. Bengal Revenue Dept., 9 August, 1884.

much investment was for reasons other than economic, "none being more addicted to castle building than gentlemen farmers who as they pay no rent think themselves superior to ordinary rules"[137].

But in general, Scottish landlords regarded investment primarily as a means of increasing their incomes. Ir was the middling lairds, "the great number of respectable proprietors... from L200 to L1000 a year", who played the most important role in capital formation. "The gentlemen of this class reside almost universally upon their estates. Their education has been liberal, and their views are enlightened. The necessities of their situation, increasing with the gradually increasing expences of polished life, have prompted them, by forcible motives, to improve their properties by every method in their power"[138]. What counted for these landlords was the bottom line.

No such necessity faced landlords in Bengal. By permanently fixing the revenue demand in 1793, the state freed <u>zamindars</u> from external economic pressure to raise rents in order to meet the revenue demand. Instead, the

137. <u>Letters of John Ramsay of Ochtertyre, 1799-1812</u>, ed. B. L. H. Horn, Scottish Historical Society, 4th Series, vol. 4, (Edinburgh, 1966), p. 131, 21 Aug. 1804.

138. Graham, <u>General View Stirlingshire</u>, p. 66.

massive decline in the real value of the land revenue encouraged _zamindars_ to subinfeudate their rights. In 1914, land revenue formed only 33% of total government revenue in India, compared to 85% in Japan in the 1880's[139]. In this sense, the Permanent Settlement did create parasitism, since it encouraged the growth of an intermediary class of tenure-holders existing on unearned income. Just as such groups were protected from taxation by the Permanent Settlement, so those who controlled the means of production were protected from excessive rent increases by Tenancy Acts. Like _zamindars_, _jotedars_ were also under no pressure to increase productivity by investing capital in order to raise rents. Instead, they were content to leave rent increases to market forces and investment remained unproductive.

It is arguable that _jotedars_ were prevented from following suit by an innate conservatism. Anthropologists explain such attitudes in terms of a world view which perceives all sources of wealth as finite; since the quantities of land and wealth which accrue to one individual can only be increased at the expense of others, the "image of limited good" acts as a brake on innovation because

139. S.S. Johl, "Agricultural taxation in developing economy; a case of India", _Indian Journal of Agricultural Economics_, vol. 27, No. 3 (1972), pp. 3, 4. In 1900, the revenue demand was estimated at 22% of the gross rental valuation of the province as measured by the Road Cess returns. J.Byrne, _Final Report Purnea_, pp. 30-31.

attempts increase one's income threaten the distribution of resources within the community[140]. Several reasons make this an unlikely explanation of jotedar behaviour.

Hostility to innovation was as much a feature of peasants in the Forth Valley as in Bengal. The experience of the inventor of an early threshing machine was typical:

> "Mr Stirling's ignorant neighbours were ... no way struck by the invention, but laughed at it, and called him a maggotty fellow. In short, like Noah with his ark, poor Mr Stirling was surrounded only with mockers, and at length he concealed his operations altogether"[141].

Next, this view exaggerates the depth of peasant conservatism. Bangladeshi farmers show remarkable innovative capacity in adapting and modifying new inputs and practices to suit their needs[142]. Finally, while the image

140. George M. Foster, "Peasant Society and the Image of Limited Good", American Anthropologist, vol. 67, No. 2, (April, 1965), pp. 293-315.

141 OSA, vol. XII, p. 522 (Kilmadock/Doune).

142. H.Brammer, "Innovations Don't Wait for Experts. A report on applied research by Bangladeshi peasants". Ceres, vol. 13, No. 2, (1980), pp. 24-35; S.D. Biggs, "Informal R & D", Ceres, vol. 12, No. 4, (1980), pp. 23-26.

of limited good is rational given a traditional agriculture, where additional labour and investment have only limited success in raising productivity, agriculture in Bengal was capable of technological change. Although productivity was low, opportunities for raising incomes did become widely available with the spread of cash crops, particularly jute. Farmers response to price is evidence that the image of limited good did not prevent innovation when market opportunities arose.

The rate of capital formation by Bengal landlords in agriculture cannot be quantified, yet the evidence suggests it was considerable. Admittedly much of this investment did little to raise agricultural productivity. But to characterise such behaviour as "parasitic" is to impose an alien rationality on Bengal landlords. Given their particular value systems or preference heirarchy, zamindars and jotedars sought to maximise their resources. Scottish landlords may have shared neither the same values nor preferences. When a jotedar dug a tank for posterity rather than profit, he was acting according to the norms of his society and class and thereby maximised his prestige. Equally, when a laird evicted his tenants and invested in improvements, he was acting according to the norms of a class which equated profit with prestige and even patriotism.

> "Here private interest and public utility seemed to go hand in hand. And hence, almost every country gentleman became a professed improver upon a greater or lesser scale[143].

To judge both jotedar and landlord by a single definition of rationality narrowly conceived in terms of profit maximisation is clearly indefensible. Labels like "parasitic" explain nothing. The puzzle is to understand why jotedars preferred this form of investment to others. What alternative forms of investment were open to them? Even if landlords in these two societies had shared identical values and preferences, they might still have shown quite different behaviour because price relationships or physical productivities in agriculture differed.

143. Ramsay, Scotland and Scotsmen, vol. 1, p. 248.

Conclusion

It is clear that Bengal agriculture generated a huge surplus, little of which was saved from consumption for productive investment. This was partly due to the nature of *zamindari* rights in land which denied the *zamindar* the absolute control over production which was the hallmark of landlords in the Forth Valley. However, even where *zamindars* did achieve some measure of control through direct management, landlord capital formation formed a relatively small proportion of the estate rental. Consequently, the bulk of rental income, which was the prime source of investment capital in the Forth Valley, was lost. *Zamindari* rent in Bengal, however, represented a relatively small proportion of total rural income. This rested largely in the hands of the stratum of landowners known as *jotedars*, the decision-makers in Bengal agriculture whose role was analogous to that of the Forth Valley lairds. Although *jotedars* were sheltered from rent increases by the protective legal umbrella of the state, enjoyed virtually unlimited economic power over their tenants, and reaped the profits from lucrative commercial crops, yet they showed little enthusiasm for capital-intensive innovation of the type favoured by their counterparts in the Forth Valley. Usury would appear to have offered higher profits than investment, but few _jotedars_ saw credit rather than land as an alternative source of income. Why then were _jotedars_ unwilling to invest? The time has come for a closer look at the potential which traditional agriculture in Bengal had for technological change.